Achieving the Beyond Waste Vision

A Framework for Moving Forward

Beyond Waste Consultant Team Issue Paper #2

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CASCADIA CONSULTING GROUP

ROSS & ASSOCIATES
ENVIRONMENTAL CONSULTING, LTD.

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Executive Summary

This issue paper, the second in the *Beyond Waste* consultant team series, has three objectives:

- To explain the methodology that the consultant team developed to identify promising starting points for achieving the Beyond Waste Vision;
- To present the results of the analysis that culminated in the seven starting points or initiatives; and
- To set the stage for Issue Papers 4-6, which describe and recommend specific actions that the state can take to achieve the Beyond Waste Vision.

THE METHODOLOGY

The methodology begins with the Beyond Waste Vision, which foresees a future in which society views waste as an inefficient use of resources. With that goal in mind, the next step is to determine the scope of the necessary transformation – in this case, the amount of and trends in waste generation in Washington State, and the economic actor sectors that generate it.

As part of step 2 of the framework, we identified the trends in waste generation that present opportunities, either because they are moving toward the Beyond Waste vision already, or because they represent high volumes of waste or wastes that require vigilant management to avoid significant risks to human health and/or the environment. We also identified economic actor sectors that are linked to these trends, along with their critical customers and leverage points. Another important part of step 2 was the development of a range of tools that could affect the decisions of the economic actor sectors and their critical customers.

This information formed the basis of step 3, in which we assessed this information to target wastes and economic actor sectors that represent effective starting points for action under the Beyond Waste Vision. Further analysis of this information led to the development of seven initiatives that the State could pursue to begin moving toward the Beyond Waste Vision.[1] In step 4, we continued our qualitative assessment of these seven initial strategies, examining the expected outcomes and feasibility of each.

INITIAL STRATEGIES

This analysis resulted in the selection of three initial strategies that warranted further research and assessment: reduction of hazardous waste in the industrial sector, establishment of an organics recovery cycle, and expansion of Green Building practices in Washington State. These initiatives are described in more detail below.

- **Encourage a green built environment in Washington State.** This initiative was chosen because construction and demolition debris represents a quarter of the solid waste generated in Washington State annually, and momentum is building

[1] These seven initiatives were designed to complement initiatives that Ecology already is pursuing. For example, Ecology already is addressing persistent bioaccumulative toxins and obsolete electronics, both of which are important for achieving the Beyond Waste Vision.

within the industry itself toward green building practices, providing the State with an excellent opportunity to leverage change.

- **Eliminate waste and hazardous/toxic substances in the industrial sector.** Ecology and the consultant team selected this initiative for three reasons: the industrial sector generates the majority of reported hazardous waste in Washington State, has a long history of interacting with Ecology, and is trending toward eliminating wastes to increase competitiveness.
- **Establish a viable organics return flow cycle.** Like construction and demolition debris, food and yard wastes also constitute one quarter of solid waste generated in Washington annually. In addition, a number of trends, such as the development of alternative energy sources and the increasing market for organic agriculture, make diverting organic matter from the waste stream more attractive and provide opportunities to leverage change.

The consultant team agreed to research policy issues and strategies as well as specific approaches to implementation, ultimately creating an Action Plan for each initiative. This research approach allows Ecology to understand both the policy issues and the mechanics of moving forward with the central aspects of achieving the Beyond Waste Vision – eliminating waste through reduced material intensity and creating return flow cycles.

SUBSEQUENT ISSUE PAPERS

The results of the research into these initiatives are presented in Issue Papers 3-5.[2] Each paper identifies the economic actor sectors, critical customers, leverage points, and barriers that are critical to developing strategies to foster Beyond Waste behaviors. The papers also describe the current waste generation and management strategies common in each initiative, and the changes that are necessary to achieve the Beyond Waste Vision. Each paper concludes with an Action Plan organized around goals that are aggressive but achievable if Ecology and its partners commit to bold and coordinated action.

[2] Issue Paper 6: Potential Enhancements to Ecology's Pollution Prevention Planning Program, was developed under a separate task of the consultant team's scope of work and does not cover one of the initiatives. Instead, as its title implies, the paper offers a number of strategies to increase pollution prevention planning to help achieve the Beyond Waste vision.

1. Introduction

The Washington State Department of Ecology has developed a vision for the future of waste management in Washington State. This vision, called Beyond Waste, calls for transitioning to a society that views the generation of waste as an inefficient use of resources, and creating social, environmental, and economic vitality through the elimination of waste.

The Beyond Waste Vision is a charge to consider current "wastes" as resources. In other words, materials flowing through Washington's economy should not be on a one-way trip to disposal, but instead should be traveling in continuous cycles where, as McDonough and Braungart write, "waste = food."[3] Such a system would not only eliminate waste, but also would add dollars and jobs to the economy.

The Department of Ecology (Ecology) retained a consultant team led by Cascadia Consulting Group and Ross & Associates[4] to help develop a plan for achieving this vision. This project had four tasks, three of which focus specifically upon waste generation and reduction:

Task 1. Develop a methodology to track waste generation rates more comprehensively

Task 2. Identify policies and activities to reduce both waste generation and the use of toxic and hazardous substances

Task 3. Analyze potential improvements to the pollution-prevention planning program[5]

The results of the work on these tasks are presented in a series of issue papers called the Beyond Waste Consultant Team Issue Papers. Issue Papers 1 and 7 in this series, *Overview and Characterization of Material Flows and Wastes in Washington State* and *Improving Waste and Materials Tracking In Washington*, present the results of the work on Task 1. This issue paper is the second in the series, and describes the consultant team's work on Task 2. It has three objectives:

- To explain the methodology that the consultant team developed to assist with analyzing the Washington State waste system;
- To present the results of our analysis of this system; and
- To set the stage for Issue Papers 3-5.

The methodology and analysis described in this issue paper led directly to the identification of initiatives that Ecology and its partners could pursue to begin to move Washington State toward the Beyond Waste Vision. Issue Papers 3-5 present the results of the consultant team's further research into three of these initiatives: reduction of waste in the industrial sector, development of an organics recovery system, and expansion of green building practices in Washington State. Issue Paper 6 summarizes our work on Task 3, an analysis of improvements to the pollution-prevention planning program. Taken together, this series of issue papers provides an analytical framework and starting points for the Washington State Department of Ecology's Beyond Waste Plan.

This issue paper answers the following key questions that guided our work on Task 2:

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[3] McDonough, William and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things.* North Point Press, April 2002.

[4] Other members of the consultant team were Project Performance Corporation, and Industrial Economics, Inc.

[5] The fourth task, the Hazardous Waste Facility Project, focuses on maintaining a stable, healthy system of facilities for the safe management of hazardous waste.

1. What is the methodology for the analyses?
2. What are some of the key trends in hazardous and non-hazardous waste generation that are expected to take place in Washington over the next 10-30 years?
3. What macro-level trends are expected to influence material and waste flows in the future?
4. What wastes and economic actor sectors could or should be targeted for initial activities to move towards the Beyond Waste Vision, considering waste quantities, waste hazards (requirements for vigilant management), the economic actor sectors responsible for those wastes, and the State's ability to influence waste flows and behaviors?
5. What tools could the State and its partners potentially pursue to achieve the Beyond Waste Vision?
6. What initiatives emerge as strong starting points for efforts to achieve the Beyond Waste Vision, considering the opportunities for leverage, the potential impact of those initiatives on waste flows, the significance of the needs addressed, and the ability to track progress?
7. What should the State do next to pursue the Beyond Waste Vision?

This issue paper begins with a discussion of the methodology developed by the consulting team to make evaluation of the complex waste system manageable. This methodology was necessary to define a viable strategic approach to achieving the Beyond Waste Vision. It then answers questions 2-7 listed above, and concludes with a short list of key concepts to consider when designing and selecting strategies to accomplish the Beyond Waste goal.

2. Methodology

The waste system in Washington State is tremendously complicated. It begins with the decisions of innumerable individuals, businesses, and institutions to purchase or create a product and ends with their decisions about how to dispose of it. A key aspect of the consultant team's work on the Beyond Waste project was the development of a methodology that makes evaluation of this complex system manageable. This section describes the methodology, including important assumptions and concepts.

KEY ASSUMPTIONS

Perhaps the most important part of understanding a methodology and its application is familiarity with the assumptions made in its development and use. The consultant team made a number of assumptions when designing and applying the Beyond Waste methodology; these assumptions are described below.

The future is unpredictable.

No matter how clear our vision, we cannot see into the future – especially the distant future – with any precision. Instead, we must rely upon the past and current behavior of industries, governments, and individuals to form educated inferences about the types of actions that will be effective at fostering change. The initial changes also are likely to have effects that the consultant team cannot predict. Therefore, in identifying initiatives for the State to pursue, we have focused upon the near term (5-10 years). As time passes, the State should evaluate the strengths and weaknesses of its approach, and modify it accordingly.

Complex systems cannot be managed.

As described above, the waste stream in Washington State is tremendously complicated. This system is far too complex for anyone to manage it completely as a whole. Therefore, Ecology and its partners must be strategic in their choices of focal points, waste streams, or systems for action.

The right levers can move the world.

The challenge of transforming Washington State society so that it views waste generation as an inefficient use of resources is daunting. With its vision, the State will be taking on the substantial task of redefining American consumerism and culture. However, it is important to remember that using the right tool – or integrated system of tools – can have tremendous effects, even on such a complex system.

There is no "silver bullet."

No single policy tool is likely to provide a "silver bullet," or ultimate solution, for reaching the Beyond Waste Vision. Instead, an integrated system of a variety of policy tools will be necessary to encourage all of the behavioral, market, and infrastructure changes that are needed to achieve the vision.

DEFINITIONS

The consultant team developed a set of terms to describe key concepts in analyzing the Washington waste system. These terms are defined below.

Economic Actor Sectors

Economic Actor Sectors, or EAS, are those groupings of individuals or organizations whose similar actions or decisions related to the use, consumption, or exchange of goods and services have a large impact on material and waste flows within the state. Examples of key economic actor sectors in Washington include the building industry, agriculture, and primary metals.

Critical Customers

Critical customers are the groups that influence economic actor sectors. Economic actor sectors respond to the needs and interests of critical customers, and in so doing, make choices that can push Washington toward or away from the Beyond Waste Vision. For example, critical customers of the building industry include building owners, homeowners, lenders, and appraisers.

Leverage Points

Leverage points are those places in a system where a well-considered push could have the greatest effect at moving Washington toward Beyond Waste. For example, leverage points in the building process include the decision to build a building, the design phase, and the deconstruction phase, among others.

Technical Materials

These items are substances that remain in a closed-loop system of manufacture, reuse, and recovery, maintaining their value through many product life cycles. These valuable resources, such as plastic, glass or metal, typically are lost when items are disposed.[6]

THE MATERIALS FLOW FRAMEWORK

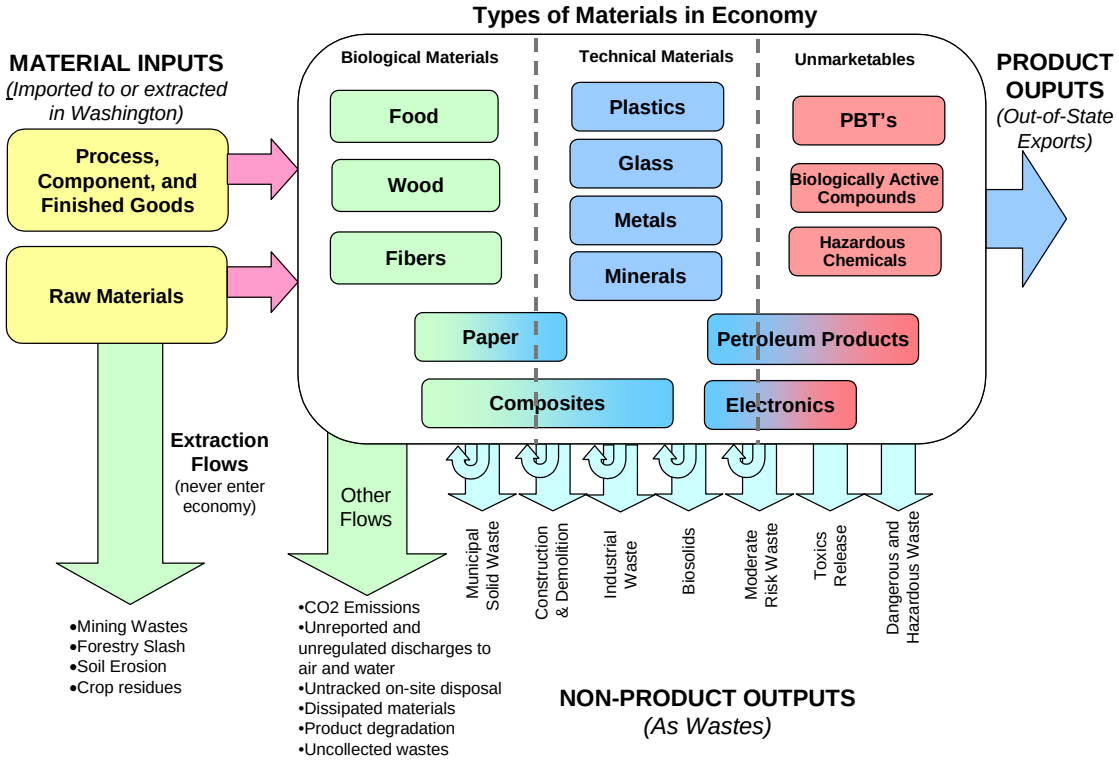
The first consultant team issue paper, *Overview and Characterization of Material Flows and Wastes in Washington State,* describes a *materials flow framework.* The materials flow framework describes the movement of materials – not just waste – through Washington's economy. It shows how raw materials enter Washington's economy, are processed by various economic sectors, and exit as waste and material flows. The framework traces the influence of many different kinds of material flows and wastes, and identifies material flows that are significant in terms of volume and/or toxicity. This information was critical to the consultant team's application of the methodology described in this chapter. A version of this framework showing the types of materials and wastes flowing through Washington's economy is shown below.

To achieve the Beyond Waste Vision, significant flows must be minimized. Broadly speaking, there are two ways to minimize these flows: maximizing material value through efficient use of resources and recovering material for high value reuse, and incorporating the principles of

[6] Definition adapted from McDonough Braungart Design Chemistry, http://www.mbdc.com/c2c_home.htm

cradle-to-cradle design. Both of these strategies would reduce waste volumes and toxicity significantly.

Figure 1: The Materials Flow Framework

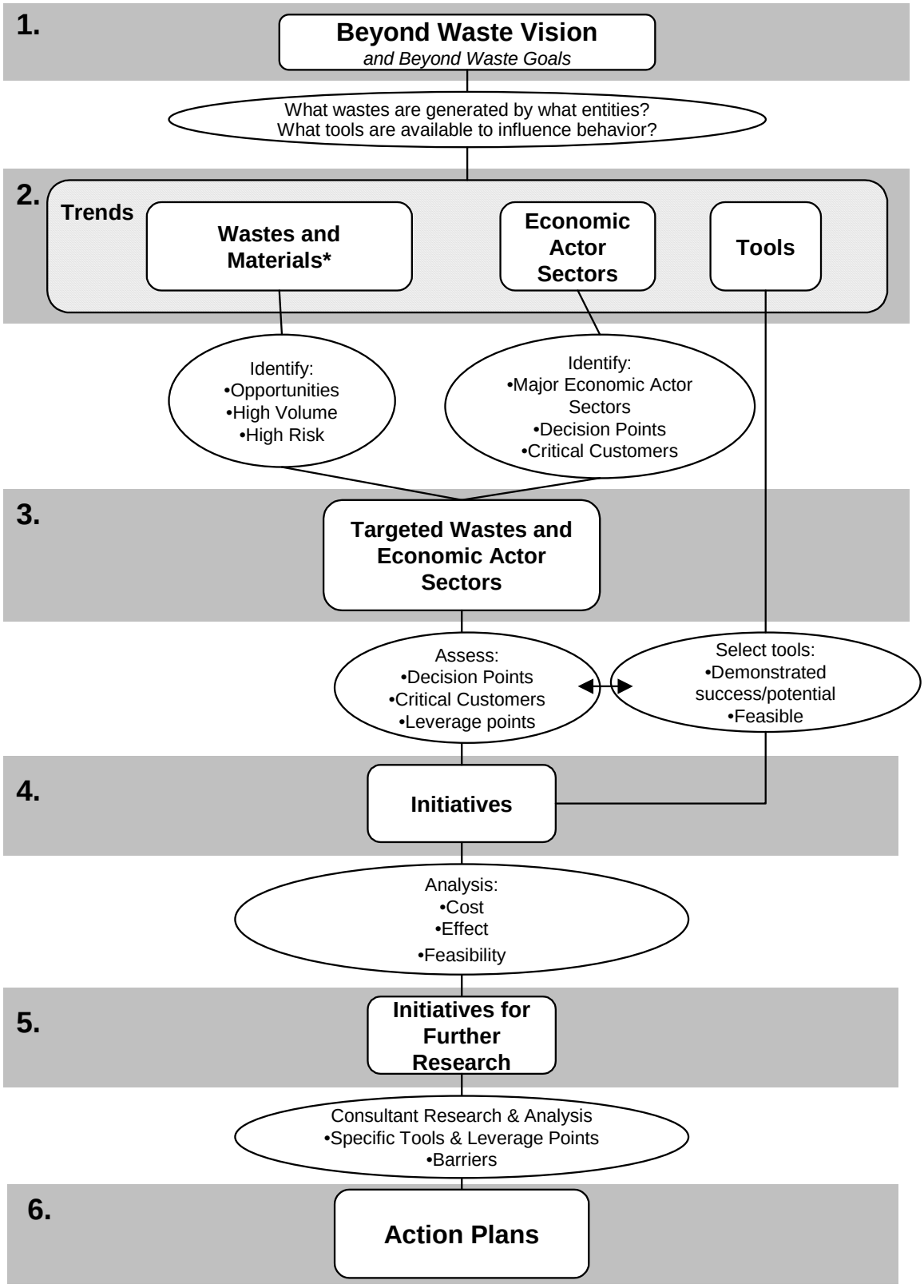


USING THE METHODOLOGY

This section describes the logic train that is the basis of the Beyond Waste methodology, which is depicted in Figure 2. The methodology begins with the Beyond Waste Vision, which identifies the desired transition to a society that views waste as an inefficient use of resources. With that goal in mind, the next step is to determine the scope of the necessary transformation – in this case, the amount of and trends in waste generation in Washington State, and the economic actor sectors that generate it.

As part of step 2, we identified the trends in waste generation that present opportunities, either because they are moving toward the Beyond Waste Vision already, or because they represent high volumes of waste, or generation of wastes that require vigilant management to avoid significant risks to human health and/or the environment. We also identified economic actor sectors that are linked to these trends, along with their critical customers and leverage points. Another important part of step 2 was the development of a list of a range of tools that the State could consider using to affect the decisions of the economic actor sectors and their critical customers.

Figure 2: Methodology for Beyond Waste Analysis



This information formed the basis of step 3, in which we assessed this information to target wastes and economic actor sectors that represent reasonable starting points for action under the Beyond Waste Vision. Further analysis of this information led to the development of seven initial integrated strategies that the State could pursue to begin moving toward the Beyond Waste Vision. In step 4, we continued our analysis of these initial strategies, examining the expected outcomes and feasibility of each.

This analysis resulted in the selection of three initial strategies that warranted further research and assessment: reduction of hazardous waste in the industrial sector, establishment of an organics recovery cycle, and expansion of Green Building practices in Washington State. The goal of this examination (step 5) was to produce Action Plans for each initiative that the State could implement to begin working toward the Beyond Waste Vision (step 6).

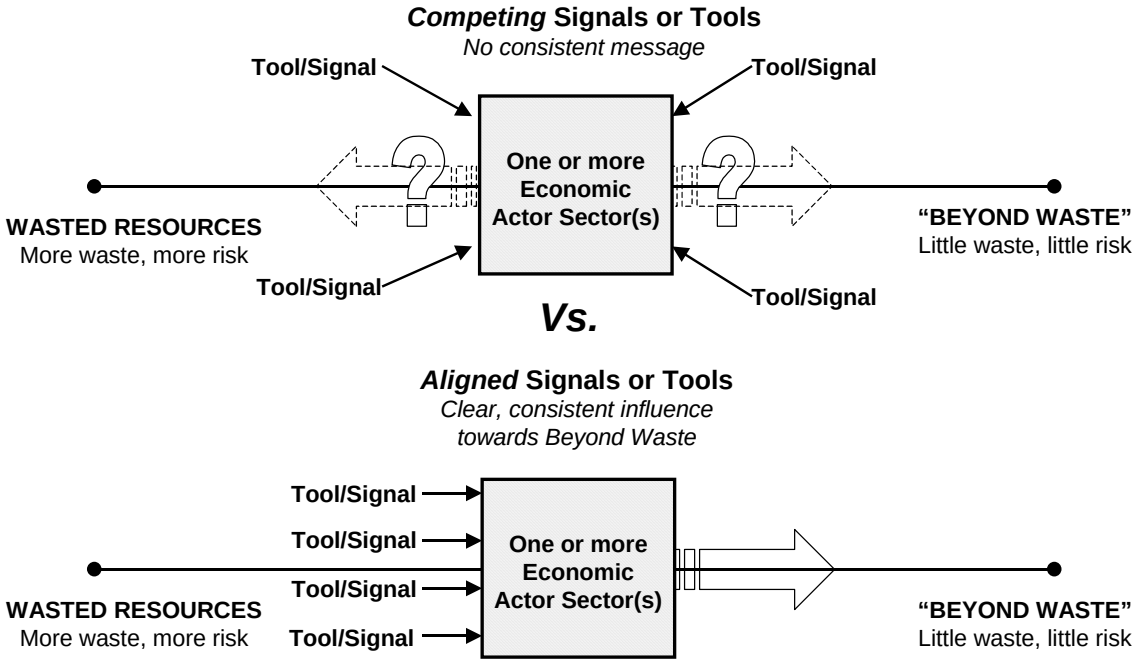
The consultant team adhered to several principles throughout this process that are important concepts for applying this framework effectively. These concepts are described below.

- **Focus on economic actor sectors.** As mentioned above, economic actor sectors are those who manage material flows and wastes. Therefore, the State must concentrate on developing a set of integrated strategies that encourages EAS to modify their waste management behavior so that the Beyond Waste Vision can be realized.
- **Identify key drivers.** Selection of these strategies relies upon the identification of the factors that motivate economic actor sectors and their critical customers, since EAS respond directly to the needs and interests of the critical customers. Key drivers for both groups include self-interest, community, law, and morality, among others. Both groups also respond to negative and positive stimuli. For example, negative stimuli include the adverse effects that waste may have on human health or the environment. Positive stimuli include the added value that materials efficiency or using waste as a resource may lend to their business, improvements in human or ecological health from Beyond Waste behavior, and the economic vitality that some Beyond Waste tools may foster through job creation or incentives. These key drivers and stimuli are forces that the State should consider when choosing strategies to foster behavior change.
- **Target leverage points.** To increase the effectiveness of any tool, the State should seek out those places in the system where use of the tool presents the greatest potential for change. These leverage points are where the State should focus its actions in order to reap the maximum benefit for the least effort.
- **Look for horses riding in the direction you want to go**. Change is difficult. Lasting behavior and culture change requires powerful and sustained motivators to counteract the forces of inertia and the costs of change. The State will be well served to leverage, or piggyback, on trends and third party actions that are fostering the desired behaviors and outcomes needed to reach the Beyond Waste Vision.
- **Align signals and incentives.** When crafting strategies to achieve change, the State should strive to develop a system of signals and incentives that are aligned to send consistent, repeated messages to EAS. The goal of these strategies should be to influence EAS' decisions from multiple perspectives but to do so with consistency, so that each EAS moves systematically toward Beyond Waste behavior. Figure 3, below, depicts this concept and the confusion that results if tools are not aligned.
- **Understand limitations.** Achieving the Beyond Waste Vision will require Ecology and others to take and sustain aggressive action. Ecology does not have control over many

aspects of Washington's waste system, and neither do its potential partners. Also, very few organizations have unlimited budgets. Therefore, success depends upon selecting initiatives that make the most of Ecology's strengths and potential partners' strengths while acknowledging legal and institutional limitations.

- **Perfection is the enemy of the good.** The desire to design or select the perfect initiative or set of initiatives to achieve a goal sometimes can result in an organization taking no action at all, especially when the actions must address a complex system. In this study, the consultant team focused upon selecting a set of reasonable initiatives that the State could take in the near term to start working toward the Beyond Waste Vision. This set of initiatives is not perfect, perhaps, in every detail. Instead it is practical and feasible, and likely to foster change for the better. Once some momentum is established toward achieving the vision, the State can evaluate the initiatives and make changes where necessary. However, it is more important to get started in the right direction than it is to ensure that every detail is in place before starting.
- **Seek continual improvement.** The behavior changes necessary to achieve the Beyond Waste Vision will not happen overnight, or even in a year or two. These changes are fundamental and far-reaching, and may not be comfortable to some EAS or critical customers. As a result, the notion of continual improvement is more useful to Beyond Waste thinking. Rather than immediate, universal change, the State should strive to achieve frequent small changes among selected EAS. Over time, these continual incremental changes can add up to the transformation that is Beyond Waste.

Figure 3: Aligning Signals to Achieve "Beyond Waste"



RESEARCH QUESTIONS

The assumptions, terms, and concepts described above combine to form a common vision of the waste system in Washington that the consultant team used as a framework for thinking

about the Beyond Waste project. The analysis itself focused upon the following key questions, which capture the essence of the research that the consultant team conducted to identify robust places for the State to start working toward the Beyond Waste Vision:

- **What are the high-volume wastes and material flows, and those that require vigilant management**, generated in the state?
- **Given current and emerging trends and technologies, where are there possible opportunities to eliminate wastes and minimize material use** – either through strategies that establish viable "return flow" cycles or strategies that reduce material use and waste generation in the first place?
- **What are the dominant economic actor sectors in Washington** (in terms of level of economic activity and material use)? **Which sectors are responsible for generating large volumes of waste and/or substantial quantities of hazardous or potentially hazardous materials**?
- **How can the behavior of the economic actor sectors that generate the most waste and/or use toxic or potentially toxic materials be influenced**? What are the key decision points of these sectors and who are their critical customers? What incentives or disincentives do different sectors have related to material and hazardous material use and waste generation? What trends are emerging that may be changing the behavior of these economic actor sectors?
- **What viable policy or program tools are available to influence these behaviors to achieve the Beyond Waste Vision**? How can different tools be aligned to maximize the potential for positive change relative to the Beyond Waste Vision?
- **Where are unique or special opportunities to influence material use and waste behaviors**? What special leverage points linked to specific policy or program actions exist, if any?
- **Given economic and political considerations, what initiatives to achieve Beyond Waste should be pursued in the short run and over the longer term**? How should these be sequenced? Which initiatives offer high potential for an early success towards achieving the Beyond Waste Vision? Conversely, what options are more appropriate for later action? Within each of these initiatives, what needs to happen to achieve the vision? Which of these actions should Ecology pursue? Which should its partners pursue?

The remainder of this document presents the results of the methodology outlined in this chapter. The paper is organized into eight chapters. Chapter 3 discusses trends in waste generation, and Chapter 4 describes macro-level trends that affect the Beyond Waste Vision. Chapter 5 examines targeted wastes and economic actor sectors. Chapter 6 presents tools and strategies to achieve the vision, while Chapter 7 outlines the initiatives that the State should consider implementing in the near term. Chapter 8 presents the consultant team's conclusions.

3. Trends in and Selected Projections of Hazardous and Non-Hazardous Waste Generation

This chapter presents trends in and selected projections of hazardous and non-hazardous waste generation that are expected to occur in Washington over the next 10 to 30 years. This assessment assuming no changes in the status quo and includes specific projections of hazardous waste generation by industry and management type.

The chapter begins with wastes traditionally thought of as solid waste, covering projections of generation of municipal solid waste, organics, wood and paper, technical materials, construction and demolition, industrial solid waste, mining, and other wastes. Note that, although these waste streams can contain hazardous substances generated by Small Quantity Generators (SQGs) or households, these potentially hazardous components of the solid waste stream are not included in the report's analysis. The projections address the non-hazardous components of the solid waste stream (found under the heading "Non-Hazardous Waste Trends) and production of dangerous wastes by the industrial sector (found under the heading "Hazardous Waste Trends"). After presenting these projections, the chapter concludes with an assessment of how these trends could provide opportunities for action.

NON-HAZARDOUS WASTE TRENDS

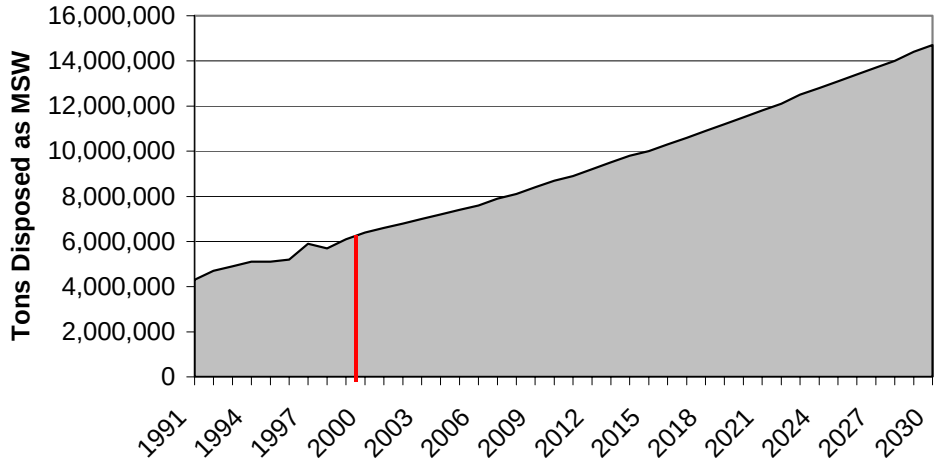
The trends discussed in this section are expected to influence the quantity and/or composition of solid waste generation in Washington State in the next 30 years. Although the trends are organized under topic headings, please note that several of the listed trends could be discussed under multiple headings.

TRENDS IN MUNICIPAL SOLID WASTE GENERATION

- **Total disposal of municipal solid waste (MSW) will increase, as will *per-capita* waste disposal.**[7] If the waste disposal trends of the past 10 years continue, Washington will generate over twice as much waste in 2030 as it did in 2001, as displayed in the figure below.

[7] Projections were calculated based on 10 years of per-capita disposal figures published in Ecology's 10th Annual status report combined with population estimates completed by Washington's Office of Financial Management (OFM).

Figure 4: Municipal Solid Waste Generation in Washington by 2030



Furthermore, *per capita* waste generation will also likely increase. Per-capita disposal in 1991 was 4.67 pounds/person/day and has grown steadily to 5.96 pounds/person/day in 2000. If this trend continues, per-capita disposal in 2030 would be over 9 pounds/person/day.

- **Recycling of materials from MSW streams will increase very slowly.** Overall recycling tonnage in Washington of MSW-type materials has increased very little in the past 10 years. Per-capita recycling has varied between 2.0 and 2.5 pounds/person/day since 1991, with a slight downward trend since 1993.[8] If the trends continue, the consultants' projections indicate that the overall quantities of material recycled will remain virtually constant at 2.4 million annual tons for the foreseeable future.

- **Per-capita and total generation of packaging wastes will continue to increase.** Per-capita generation of packaging wastes in the United States has been increasing for decades. Although it has slowed in recent years, gradual growth of per-capita packaging generation is likely to continue. Per-capita generation has increased from 0.8 pounds/person/day in 1960 to 1.4 in 1990 to 1.5 in 2000.[9] If these trends continue, per-capita generation will increase modestly to about 1.7 pounds/person/day by 2030. In Washington, these trends imply about 1.5 million tons of packaging wastes in 2000 increasing to 2.5 million tons by 2030.[10]

- **Persistent Bioaccumulative Toxics and other potentially toxic/hazardous materials will continue to be common in MSW.** Examples include mercury in batteries, thermometers, thermostats, fluorescent lamps; lead in computers, TV's, and batteries; arsenic in pressure-treated wood; and cadmium in rechargeable batteries. The increasing prevalence of electronic devices (see discussion of obsolete electronics, below) likely will increase the quantities of many of these toxic materials included in MSW.

[8] Washington State Department of Ecology. *Solid Waste in Washington State, Tenth Annual Status Report*: Washington State Department of Ecology Solid Waste and Financial Assistance program, page 78.
[9] Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: EPA Office of Solid Waste and Emergency Response, June 2002.
[10] These figures reflect packaging waste generation, which includes both recycling and disposal. Washington state projections are made on a per-capita basis.

- **Millions of tires will continue to be generated in Washington every year.** According to Ecology estimates, over 5 million tires are discarded annually in Washington, or over 50,000 tons.[11] This number is likely to grow, as there are more cars being driven more miles each year.[12] Although few tires are disposed in MSW landfills, closed-loop recycling opportunities for tires are minimal, and have declined.

TRENDS INFLUENCING GENERATION OR DIVERSION OF ORGANIC ("BIOLOGICAL") MATERIALS

- **Compostable organics will continue to occupy a large share of disposed MSW.** Nationally, food and yard wastes comprise about 23% of disposed MSW.[13] Although no recent Washington statewide waste composition study is available, food wastes and yard wastes in King County have comprised 20% - 25% of disposed MSW since 1993, with per capita disposal of food waste increasing in the residential sector.[14] These trends are likely to continue. Additionally, about 5% of King County's waste stream is compostable paper that is not recyclable.
- **Biosolids generation will continue to increase.** As population expands, generation of solid human excreta will increase accordingly. Much of this material will be captured by wastewater treatment facilities and processed into biosolids.
- **Use of composted organic materials will increase in agricultural and residential landscaping.** Organic farming, which uses large quantities of organic materials as inputs, is increasing rapidly in Washington. Acreage of certified organic property in Washington has increased from only 6,200 acres in 1993 to 40,000 acres in 2001.[15] This trend is expected to continue as consumers continue to demand certified organic food products. Use of compost is also increasing in residential applications. A King County study released in 2000 found that use of compost had increased since 1995, a trend that was expected to continue.[16]

TRENDS REGARDING WOOD AND PAPER

- **Wood and paper will continue to be generated in large quantities.** Despite the electronic revolution, generation of paper has not subsided. Nationally, paper has comprised over 35% of generated MSW since 1970, and shows no signs of decline. Recycling of paper has increased, but paper still comprises about 30% of disposed waste. Generation of wood represents a smaller portion of generated MSW (only about 5%), but a significant portion of construction and demolition waste. In King County (outside Seattle) alone, construction and demolition activities generated over 330,000 tons of wood in 2001.[17] Wood wastes will continue to be generated as buildings (especially residential homes) are remodeled or demolished, although future construction may use less wood (see construction and demolition section, below).

[11] Based on research conducted by Jay Shephard in support of "Automotive-vehicle pollution is more than just hot air", Focus #02-07-007, February 2002.
[12] Johnson, Jim, "An active retirement," *Waste News*: Volume 7, Issue 23, March 4, 2002.
[13] Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: EPA Office of Solid Waste and Emergency Response, June 2002.
[14] Based on analysis of waste composition studies commissioned by King County Solid Waste Division.
[15] Washington State Department of Agriculture News Release, May 13, 2002.
[16] King County Department of Natural Resources, "Feasibility Study of Organic Materials Management in King County: Market Assessment", completed by Cascadia Consulting Group, January 2000.
[17] Based on survey and sampling data collected by Cascadia Consulting in 2002.

- **The availability of virgin pulp and timber from Washington will decline, potentially creating an opportunity for recycled paper pulp to compete better in the market.** Timber harvest in Washington has declined by over 40% since the mid-1980's, and is projected to decline an additional 16% before 2020.[18] This trend is expected to contribute to a significant increase in the price of wood chips for paper pulp in the next couple decades.[19] Given this increase, use of recycled paper as a feedstock may become increasingly cost-effective.
- **Purchasing of recycled-content paper and certified sustainably harvested wood will increase, especially as encouraged by government procurement requirements.** Local and national governments have adopted procurement requirements for recycled-content products and sustainably harvested wood. These requirements are likely to continue and expand. For example, the City of Seattle is currently researching ways to expand its environmental purchasing program.[20]

TRENDS CONCERNING TECHNICAL MATERIALS

- **Technical materials will occupy a significant portion of the waste stream.** In particular, generation of plastics will likely increase. Nationally, plastics generation has increased from 0.1 pounds/person/day in 1960 to 0.4 in 1990 to 0.5 in 2000. As more and more products (particularly packaging) are made from plastic, this trend is likely to continue. Plastics now represent about 11% of generated waste, a fraction that has increased steadily over time. Generation of other technical materials, such as glass and metals, also represent about 11% of the generated waste stream, although generation of these materials has slowly been declining.[21]
- **The quantity of obsolete electronics (e.g., computers, cell phones, TVs) entering the waste stream will increase rapidly.** As mainstream consumers have increasingly adopted electronics, the quantities of electronics that become obsolete have grown rapidly. In Washington and Oregon, an estimated 1,600 computers become obsolete every day.[22] Furthermore, other electronic devices also show similar trends. For example, cell phones typically are replaced every 1.5 years, and cell phone subscription rates double about every three years.[23] Nationally, there are about 129 million cell phones in use, [23] at least 2 million of which are estimated to be in Washington. As electronics become obsolete, the need to manage them as wastes will increase rapidly.
- **The number of discarded used vehicles will continue to grow.** According to Ecology estimates, about 400,000 used vehicles are taken off Washington's roadways each year.[24] This number will likely grow at a rate as least as fast as population.[25]

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[18] Source: Washington State Employment Security Department, Forestry Industry Profile, http://www.wa.gov/esd/lmea/sprepts/indprof/forestry.htm
[19] Washington State Employment Security Department, Pulp and Paper Industry Profile, http://www.wa.gov/esd/lmea/sprepts/indprof/pulp.htm
[20] As reported on the City of Seattle's web site, http://www.cityofseattle.net/environment/purchasing.htm
[21] Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: EPA Office of Solid Waste and Emergency Response, June 2002.
[22] Northwest Product Stewardship Council. "Governments saddled with electronic scrap." NWPSC Policymaker's Bulletin, volume 1, issue 1: November 2001.
[23] Fishbein, Bette "Waste in the Wireless World: The Challenge of Cell Phones." INFORM, Inc., 2002.
[24] Based on research conducted by Jay Shephard in support of "Automotive-vehicle pollution is more than just hot air", Focus #02-07-007, February 2002.
[25] "This Place on Earth 2002: Measuring What Matters." Northwest Environment Watch: Seattle, 2002.

Most metal in vehicles is recovered for recycling, but the remaining materials (plastics, fines, glass, textiles, etc., known as fluff) are disposed. Because of the increased use of plastics and composite materials in automobiles, the portion of each vehicle that is recyclable metal is declining. In addition, hazardous materials in vehicles, particularly mercury switches, are a growing concern.[26]

- **Carpet discards are expected to increase by over 40% in the next 10 years.** Carpet currently represents about 2% of the waste stream, but disposal is expected to increase significantly.[27] The infrastructure and processes to recycle carpet fibers (mostly nylon) are still under development.

TRENDS IN GENERATION OF CONSTRUCTION AND DEMOLITION WASTES

- **Significant construction of new residential and commercial buildings will continue.** Development efforts will likely remain strong, particularly in central Puget Sound. From 1983-1995, at least 15,000 residential units were built annually in central Puget Sound. Since 1996, at least 25,000 residential units have been built annually.[28] Given continued development pressure, many thousands of units will continue to be built annually. Building is also likely to continue in the commercial sector to accommodate the more than 500,000 new jobs expected by 2020.[29]
- **More building products with recycled content will emerge.** As virgin wood becomes more costly, manufacturers have been turning to other feedstock to make building materials. For example, Boise Cascade is building a new facility in Satsop to manufacture a siding product made with 50% plastic film and 50% recycled wood.[30] Although these products are made from recycled materials, they may be difficult to separate from other wood-based products (after use or demolition) for appropriate re-manufacture.
- **Recovery and recycling of construction and demolition wastes will increase.** According to the Ecology's Solid Waste and Financial Assistance Program's annual report, diversion of construction and demolition wastes is increasing.[31] In particular, as local jurisdictions focus on diverting these materials and markets emerge, recycling of construction and demolition materials likely will continue and expand.
- **Replacement and disposal of wood treated with chromated copper arsenate will increase dramatically.** In 2001, industry professionals expected that the amount of arsenic-treated wood headed for disposal would peak in about 15 years.[32] However, this peak may come sooner if consumer concern rises as a result of the February 2002 Environmental Protection Agency (EPA) announcement of a phase-out of arsenic-treated wood.[33] As concern mounts over use of this wood in decking and play structures, large amounts may be replaced, creating a significant waste management

[26] Johnson, Jim, "Roadmap to Reduction," *Waste News*: Volume 7, Issue 23, March 4, 2002.
[27] Johnson, Jim, "Carpet stakeholders sign landmark pact," *Waste News*: Volume 7, Issue 20, Jan. 21, 2002.
[28] Puget Sound Regional Council, "Puget Sound Trends", December 2001.
[29] Employment forecasts are produced by the Washington State Office of Financial Management.
[30] Boise Cascade Corporation 2000 Annual Report
[31] Solid Waste and Financial Assistance Program, 2001. *Solid Waste in Washington State*. Washington State Department of Ecology, Publication #01-07-047.
[32] Tom, Patricia-Anne, "Good Wood Gone Bad," *Waste Age*, Aug 9, 2001.
[33] "Arsenic-treated wood for homes to be phased out", *Seattle Times*, Feb. 13, 2002.

issue. Furthermore, disposal of treated wood is managed (with some exceptions) as a dangerous waste, which complicates possible diversion efforts.[34]

- **The number of new buildings with Leadership in Energy and Environmental Design (LEED)™ certification may increase.** The LEED™ standard is a voluntary, national standard for producing high performance sustainable buildings. Local governments are increasingly turning to LEED™ certification[35] as a means of demonstrating their environmental stewardship. For example, in early 2000, the City of Seattle called for new City-funded projects and renovations with over 5000 ft^2 of occupied space to achieve a Silver rating using the LEED™ system.[36] Over 40 new public buildings were planned in 2000. If LEED™ certification becomes more widespread, waste generation from the construction sector could decrease and use of environmentally preferable materials could increase.

TRENDS IN INDUSTRIAL SOLID WASTE

- **Fewer wastes will be managed on site.** Government regulations have changed how industrial facilities manage their solid waste. These regulations, combined with increased disposal costs, have driven most industries to consider alternatives to disposal.[37] Less industrial wastes are being managed on-site, yet disposal remains the primary means of dealing with these wastes. As industrial materials are used as inputs to other processes (e.g. fuel burning and composting) industry concern over proper management of waste constituents, particularly bioaccumulative toxins (such as dioxin), is increasing.[38]

TRENDS IN MINING WASTES

- **Wastes from lead mining will likely re-emerge and increase.** Although lead mining has been inactive in Washington since 1977, a lead mine in Pend Oreille County (northeastern Washington) will reopen in 2002 or 2003 and produce 14,300 tons of lead annually.[39] Renewed mining may result in release of lead to neighboring ecosystems or communities.
- **Gold mining wastes will continue in northeastern Washington.** Although gold production will decrease somewhat due to the depletion of the Lamefoot deposit, mining will continue in other deposits, with additional reserves recently announced.

TRENDS IN OTHER WASTES

- **Emissions of greenhouse gases from fossil fuel combustion will increase, especially for transportation and electricity generation.** Emissions of $C0_2$ are expected to increase with population growth, or at least 1% per year. Most of this

[34] As reported on the HWTR website, http://www.ecy.wa.gov/programs/hwtr/
[35] LEED™ stands for Leadership in Energy and Environmental Design. The LEED™ rating system was developed by the US Green Building Council to evaluate environmental performance over a building's life cycle. For more information, see http://www.usgbc.org.
[36] As reported on the City of Seattle's web site, http://www.cityofseattle.net/sustainablebuilding/
[37] According to Carol Kraege, Washington State Department of Ecology.
[38] An upcoming Department of Ecology study will focus on dioxin generated by the paper industry.
[39] "The Metallic, Nonmetallic, and Industrial Mineral Industry of Washington in 2000." *Washington Geology*, Vol. 29, no1/2, Sept. 2001.

growth will occur from the burning of fossil fuels for transportation.[40] In addition, two new gas-fired electricity generation plants are currently under construction in Washington, which also will contribute to $C0_2$ emissions.[41]

- **Alternative energy sources will emerge and increase in the long-term.** Washington is becoming a national leader in wind power, as the nation's largest wind-power plant is being constructed near Kennewick.[42] Additionally, the transportation market is expected to experience a shift towards alternative fuels, particularly electric/hybrid cars and hydrogen fuel cells, in the next 20 to 30 years.[43] These trends, if realized, would help reduce emissions from burning of fossil fuels and potentially wastes from coal mining. However, they could introduce new waste streams, such as the larger lead-acid batteries required by electric cars or fuel cells.

HAZARDOUS WASTE TRENDS

For this study, the consultant team developed projections of Dangerous Waste generation for 2005 and 2010 from a calendar year 2000 baseline. To be consistent with previous Ecology analyses of Dangerous Waste, the projections focus on primary, recurrent, non-wastewater, non-mixed radioactive wastes. Because the projection methodology deliberately holds the relationship between Dangerous Waste generation and dollar units of Gross State Product constant at its baseline 2000 level, the forecast provides a view of the future that could emerge if no further improvements in waste efficiency are achieved.[44]

The projections of Dangerous Waste generation for 2005 and 2010 indicate that generation of hazardous waste over this ten-year period will remain relatively constant, starting with a baseline of 98,260 tons and declining between 8 and 9 percent to 89,747 tons in 2005 and increasing 8 to 9 percent to 97,698 tons in 2010. Although overall generation remains fairly constant, this trend masks substantial changes in forecasted generation for a variety of industries. Seven industry sectors that are important from a waste generation volume standpoint are forecasted to experience substantial waste generation increases ranging from 13 to 67 percent. These seven sectors are described below.

- SIC 28 – Chemicals and Allied Products – has baseline generation of 17,162 tons (17 percent of total) with forecasted increases in employment and worker productivity increasing waste generation by 43 percent to 24,684 tons (24 percent of total) in 2010.

- SICs 22, 29, 30, 31 – EMNO, which includes textile mills, petroleum refiners, and producers of rubber and leather products, although generation is dominated by petroleum refining – has baseline generation of 2,992 tons (3 percent of total) with increasing employment and productivity driving a 40 percent increase to 4,176 tons in 2010.

- SICs 91 through 97 – Government – has baseline generation of 2,884 tons (3 percent of total) with projected employment increases offsetting worker productivity declines to increase waste generation 13 percent to 3,260 tons in 2010.

[40] Kerstetter, James D. "Greenhouse Gas Emission in Washington State", Washington State Office of Community, Trade and Economic Development's report, available at http://www.energy.cted.wa.gov/papers/wa-ghg99.htm
[41] As reported by the Washington State Energy Facility Site Evaluation Council, http://www.efsec.wa.gov/
[42] "Largest Wind Farm to be Built in Washington State," Energy Online Daily News, March 15, 2002, http://www.energyonline.com
[43] Garsten, Ed, "Automakers charged up over fuel-cell generators", *Seattle Times*, July 30,2002.
[44] Ross & Associates Hazardous Waste Projections

- SICs 70 through 89 – Services – has baseline generation of 1,292 tons (1.3 percent of total) with increasing employment and productivity driving up waste generation by 50 percent to 1,938 tons in 2010.

- SIC 36 – Electrical and Electronic Equipment – has baseline generation of 1,256 tons (1.2 percent of total) with projected decreasing employment initially driving down waste generation to a low of 964 tons in 2005, with a rebound in projected employment and consistent worker productivity gains resulting in a 64 percent increase to 2,059 tons in 2010.

- SICs 50 and 51 – Wholesale Trade – has baseline generation of 1,034 tons (1 percent of total) with increasing projected employment and worker productivity driving up waste generation by 42 percent to 1,472 tons in 2010.

- SIC 35 – Industrial Machinery and Equipment – has baseline generation of 668 tons with strong productivity and projected employment growth leading to a 67 percent change to 1,117 tons in 2010.

Declines in two major waste-generating industry sectors, primary metal industries and aerospace, are forecasted to offset these areas of increase. These two sectors are described below.

- SIC 33 – Primary Metal Industries – has baseline generation of 59,906 tons (59 percent of total) with a steep employment decline that is not offset by productivity increases leading to an estimated decline to 48,915 tons in 2010. (Note that Washington State OFM produced the employment projections utilized for this estimate prior to the 2001 – 2002 energy price shift that altered employment and production in the primary metals industries substantially. Telephone contact with OFM representatives indicated OFM plans to lower its projections of aluminum employment by an additional 40 percent over the next five years. Moreover, Department of Ecology representatives expect that, due to the smelter shut downs during 2001 and 2002, dangerous waste generation likely was very small during these years.)

- SIC 373 – Aerospace – has baseline generation of 8,245 tons (8.4 percent of total) with decreasing employment and level to slightly declining productivity leading to a decrease to 6,661 tons in 2010.

The consultant team also prepared projections for the potential demand placed on off-site (commercial) permitted hazardous waste treatment, storage, disposal or recycling capacity. These projections indicate an overall expected decline in primary, recurrent waste demand for commercial management capacity from 77,830 tons in 2000 to 69,433 tons in 2010. Methods of disposal that show notable declines include landfilling decreasing from 31,651 to 26,399 tons, other treatment from 7,945 to 6,672 tons, high temperature metals recovery from 12,338 to 10,075 tons, and cyanide destruction followed by chemical precipitation from 4,752 to 3880 tons. In 2000, excluding the 12,338 tons going to high temperature metals recovery, 2,484 tons (3 percent of total) of waste went to commercial recycling for management with various forms of either metals and solvents recovery as the primary activity. The projections indicate that, excluding high temperature metals recovery, recycling will increase modestly to 3,143 tons and account for 5 percent of total waste managed at commercial treatment, storage, disposal or recycling facilities in 2010.

Note that the forecasts do not include hazardous waste generation activity associated with Small Quantity Generators (SQGs)[45] or households.[46] General population and employment trends, discussed in the next section, indicate it is very likely that SQG and household[47] generation will increase over the next ten years. Many SQGs are associated with service industries (e.g., vehicle maintenance and repair, laundries, photofinishing) or construction activities. As service-oriented enterprises, business growth in this area tends to be responsive to increases in population. Increases in population will also drive more or bigger households and, in turn, drive greater use of household cleaners and other household hazardous wastes.

OPPORTUNITIES FOR ACTION

The material and waste projections presented above highlight the challenge the State faces in realizing its Beyond Waste Vision. Across the board, both the volume and rate of material and product utilization are expected to increase. At the same time, in a number of key areas such as paper and hazardous waste, recycling efforts are expected to increase only modestly and likely will fail to keep pace with projected waste increases. Fortunately, opportunities for action are evident. For example:

- Increases in the demand for organic foods, supported by independent certification systems that allow for clear product differentiation and expected growth in the acreage devoted to organic farming may strengthen the market for composted, organic wastes. This market likely will be further enhanced by the increasing willingness of residential and institutional actors to use composted organics for their gardening and landscaping needs.
- Consumer concern over compost contaminants will linger, and provide opportunity for reducing the use of toxic products. Recently, the presence of the persistent pesticide clopyralid in municipal composts has damaged consumer confidence in compost products.[48] Washington State University, the private compost industry, and the Washington State Department of Agriculture have worked together to avoid most problems before they occurred, but some concerns still remain, as does a need to foresee and prevent similar instances in the future.
- Green purchasing efforts, supported by the development of independent certification systems, are emerging across a variety of sectors, providing proven models and market infrastructure that can be leveraged and directed at key materials and waste streams. For example, the increasing use of the LEED™ certification system and the expansion of infrastructure to support reuse or recycling of old building materials provide important building blocks for strategies to influence the way buildings are constructed, remodeled, and demolished. Likewise, the emergence of new energy sources and modes of transportation (wind power and alternative motor vehicles) provide options for directing energy and transportation purchases away from technologies that produce CO_2.
- Certain other material and waste flows also emerge as priorities for attention. The Dangerous Waste projections developed for this study indicate that a variety of industries can be expected to increase waste generation quite substantially in the absence of intervention. Dangerous Wastes are particularly problematic as a result of the complex

[45] Under Ecology guidelines, a business is considered a small-quantity generator if it generates less than 220 pounds of dangerous waste per month.
[46] Household hazardous waste includes items such as paint, pesticides, fertilizers, household cleaners, and motor oil.
[47] Washington State uses the term Moderate Risk Waste, or MRW, to encompass household and SQG generation of hazardous waste. (http://www.ecy.wa.gov/pubs/0007041.pdf)
[48] Uhlar-Heffner, Gabriella, 2002. "Clopyralid Developments in Washington State." *BioCycle 43:2, p. 51.*

management and regulatory attention they require to ensure an acceptable level of risk is maintained. This complex system built around "cradle to grave" vigilance requires the dedication of substantial private and public resources that could otherwise be directed to more productive investments. Other technical materials, particularly electronic devices, are expected to enter the waste stream in increasing volumes but options for diversion from landfills currently are limited. Although both the Dangerous Wastes and technical materials flows present substantial Beyond Waste challenges, their significance in terms of volume, vigilance requirements, and lost opportunity indicates an evident need for attention.

4. Key Trends Affecting the Beyond Waste Vision

This chapter highlights key trends that hold the potential to influence the volume, composition, and use or management of important material and waste flows in Washington State over the next several years. Some of the trends are likely to result in the production of less waste and lower risk wastes; others may result in the production of greater waste volumes or more technically complex wastes. Still other trends pertain to how wastes could be managed in Washington State.

TRENDS PROMOTING LESS WASTE AND LESS RISK

Several powerful trends are driving reductions in waste generation, material use, and environmental risk in key economic actor sectors. While many of these trends focus on improvements in efficiency and resource productivity, others involve the emergence of non-traditional business practices that seek to redefine various economic actor sectors' relationship with material use and wastes, significantly reducing their ecological footprint.

RESOURCE PRODUCTIVITY IMPROVEMENTS

A convergence of economic, corporate management, technology, and regulatory trends is yielding significant improvements in resource productivity at numerous companies and industrial sources in Washington and the U.S. Increasing global integration, capital mobility, and overseas industrial development are forcing companies in many U.S. industries to aggressively improve their customer responsiveness, product quality, and cost-competitiveness to secure market share and remain profitable. In response to these competitiveness pressures, companies are seeking to do the following:

- Reduce or manage business risk;
- Improve significantly the productivity of human and material resources;
- Optimize utilization of production assets (e.g., plants, equipment); and
- Eliminate all non-value adding activities (e.g., waste).

Effectively reducing and managing business risk often requires companies to expand their definition of customer to include those actors whose behavior or responsiveness the business depends upon to maintain its "license to operate" and to deliver consistently increasing shareholder value. The definition of "customer" is broadening beyond the traditional product

purchaser and shareholder to include financial markets, employees, neighbors, non-governmental organizations, and interested members of the public. These customers are intensifying demands for improvements in areas such as corporate accountability, transparency and reporting, and social and environmental performance.

To enhance resource productivity, optimize asset utilization, and eliminate waste, U.S. companies increasingly are adopting advanced, or "lean", manufacturing systems.[49] Case studies demonstrate that these operations-based, continual improvement systems hold significant promise for reducing solid and hazardous wastes stemming from packaging, defective parts and products, overproduction, and raw material and component damage and spoilage. For example, Boeing's Commercial Airplanes Division has realized resource productivity improvements ranging from 30% to 70% when lean initiatives are implemented.[50] Such successes have prompted many, including Paul Hawken, Amory Lovins, and L. Hunter Lovins in their book *Natural Capitalism*, to advocate lean production systems as a strategy for substantially improving the resource productivity of U.S. industry and reducing the ecological footprint of economic activity. William McDonough and Michael Braungart note that products, on average, contain only 5% of the raw materials involved in the production and delivery of the product.[51] Clearly there is room for leaner production and resource productivity improvements.

Implementation of environmental management systems (EMS) is also growing among U.S. companies and industry sectors that seek to improve the effectiveness and consistency of their environmental management and risk reduction activities within a continual improvement framework.[52] The rise of ISO 9001 and ISO 14001 quality and EMS standards, as well as numerous industry-tailored quality and EMS standards and certification programs, illustrate the increasing industrial attention to risk reduction and resource productivity.

Important regulatory trends fostering industrial waste and risk reduction include tightening environmental requirements and enhanced regulatory recognition of and incentives for systemic environmental improvement. While certain regulatory requirements are occasionally relaxed, the overall trend at the federal and state levels is toward increasingly stringent environmental requirements. Regulatory agencies are also demonstrating increased responsiveness to companies that demonstrate a commitment to continual improvement and pollution prevention, as exhibited by initiatives such as USEPA's Performance Track, Pollution Prevention in Permitting (P4) programs, EMS-related Supplemental Environmental Projects (SEPs), and Oregon's Green Permits program. In addition, an important trend among environmental

[49] Common lean manufacturing systems include just-in-time production, cellular/one-piece flow manufacturing, total productive maintenance, 5S, kaizen/rapid improvement processes, and Six Sigma (see http://www.productivityinc.com for additional information and resources on lean methods. For information on the links between lean manufacturing and waste elimination at The Boeing Company's operations in Washington State, see USEPA's August 2000 report *Pursuing Perfection: Case Studies Examining Lean Manufacturing Strategies, Pollution Prevention, and Environmental Regulatory Management Implications*, prepared under USEPA Contract # 68-W50012.

[50] See the USEPA lean manufacturing case study report mentioned above, as well as the Shingo Prize for Manufacturing Excellence award recipient case studies (http://www.shingoprize.org).

[51] William McDonough and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things*. New York: North Point Press, 2002, p. 28.

[52] See http://www.epa.gov/compliance/incentives/ems/index.html and http://www.epa.gov/sectors/ for information on USEPA EMS-related initiatives. The Global Environmental Management Initiative (GEMI) has developed numerous case studies documenting corporate efforts to improve environmental performance using environmental management systems and other tools (see http://www.gemi.org).

regulatory agencies over the past 15 years has been to use public environmental reporting as a vehicle for driving industrial environmental performance improvement.[53]

Technology trends also are spurring resource productivity improvements through the miniaturization and dematerialization of many products. Micro- and nanotechnology promise to advance this trend of increased value per unit of material to a new level.[54] Materials science research has also made significant advances in discovering and designing high performance materials that are made of renewable resources.

Such resource productivity improvements are not limited to the industrial and manufacturing sectors. Satellite and information technology-based "precision farming" techniques are yielding vast improvements in the productivity of agricultural inputs such as fertilizers, pesticides, and irrigation water.[55]

EMERGENCE OF ALTERNATIVE BUSINESS MODELS

In addition to trends driving improvements in efficiency and resource productivity, there is also evidence that new business models are emerging that address what William McDonough and Michael Braungart refer to as "eco-effectiveness."[56] Such production models typically aim to deliver products and services that are attentive to and complement natural systems, transforming "waste into food." While these trends are undoubtedly in their infancy, there are growing factors such as customer demand, prospects of increased regulation, and competitiveness pressures encouraging industry to move in this direction.

Increased attention to product lifecycle impacts and extended producer responsibility (EPR) are compelling an increasing number of companies to examine what they make, and not just how they make it. For example, companies are increasingly developing Design for Environment programs to examine the lifecycle impacts and eco-effectiveness attributes of their products and services.[57] Hundreds of organizations, including the City of Seattle, Electrolux, IKEA, Nike, Starbucks, and The Home Depot are using The Natural Step as a tool for rethinking their business model.[58] The Oregon Natural Step Network has approximately 140 corporate members.

One growing trend has been toward developing "products of service," where a company retains ownership of the actual physical product and leases its services to the customer. Such an approach can align eco-effectiveness goals with business goals, as the business incentives favor products that are durable, long lasting, and easy to reuse or recycle.[59]

In the agricultural sector, production and sales of organic products are transforming the conventional food production model. Organic farming is a production system that avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic

[53] Toxics Release Inventory (TRI) reporting exemplifies how public reporting of corporate environmental performance can drive behavior change. USEPA's 33/50 Program helped to leverage rapid reductions in the release of selected TRI chemicals.
[54] Massachusetts Institute of Technology. "The State of Innovation." *Technology Review*. June 2002, pp. 55-63.
[55] See John Deere & Company Services & Support at http://www.deere.com/servlet/*AgHomePageServlet.*
[56] William McDonough and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things.* New York: North Point Press, 2002.
[57] See http://www.epa.gov/dfe/ for information on USEPA's Design for Environment initiatives.
[58] See http://www.naturalstep.org for information and case studies related to The Natural Step.
[59] Examples of the "products of service" concept are discussed in *Natural Capitalism* by Paul Hawken, Amory Lovins, and L. Hunter Lovins (New York: Little, Brown and Company, 1999).

wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests. The U.S. has almost doubled its acres of organic farmland since 1997. As discussed below, customer demand for organic goods is growing rapidly.

PUBLIC AWARENESS AND EMPOWERMENT AROUND ENVIRONMENT & HEALTH

Public awareness and interest in environmental quality, health, and well being have been steadily increasing and becoming more sophisticated over the past 30 years. Public awareness has expanded from a focus on visible, "close-to-home" environmental issues, such as litter and local air and water quality, to include familiarity with more abstract, global issues such as ozone depletion, climate change, and biodiversity. Regular reporting on environmental issues has become commonplace in the mainstream media, further raising public environmental awareness.[60] There is increasing evidence that the growing public environmental awareness is shifting consumption patterns and political activism to address more environmentally sustainable practices.

Public opinion polls consistently show that the public places high priority on environmental quality. In 2000, the *LOHAS Journal* reported that the U.S. "lifestyles of health and sustainability" (LOHAS) industry posted sales exceeding $230 billion.[61] Sociologist Paul Ray and psychologist Sherry Ruth Anderson recently released a best-selling book, titled *The Cultural Creatives: How 50 Million People Are Changing the World*, which documents a significant transformation in lifestyle patterns associated with sustainability, social justice, and health.[62] The research draws upon 13 years of survey research studies on over 100,000 Americans, plus over 100 focus groups and dozens of in-depth interviews.

Evolving lifestyle patterns are reflected in the rising consumer interest in organic foods. A 1997 report showed that 52 percent of American consumers are open to, if not seeking, organic and "green" alternatives in the supermarket.[63] Sales of organic products in the U.S. are projected to rise rapidly in the coming years, increasing by 20 percent to 25 percent annually.[64] Large food corporations, vying for a piece of the fast-growing natural foods market, have been absorbing small companies and selling new products to appeal to organic foods customers. General Mills, for example, purchased Small Planet Foods in 1999, and just last month released four new cereals under Small Planet-owned Cascadian Farm (located in Sedro Wooley, Washington), one of the top-selling organic brand names. Organic foods, once viewed as a fringe market by some of the largest food conglomerates, have a growth rate of more than twice that of traditional foods. And although sales at traditional supermarkets dwarf organic market sales, their growth is just 1 percent a year. By contrast, Whole Foods Market, the nation's leading natural foods retailer, is experiencing annual sales growth of more than 20 percent.[65] Consumer demand is a powerful lever for changing production patterns.

There are also signals of increasing community empowerment around environmental issues, as evidenced by the rapid proliferation of local, regional, national, and international non-

[60] For an example, see *The Economist's* annual "Survey of the Global Environment" issue (July 6, 2002).
[61] See http://www.lohasjournal.com.
[62] Paul Ray, Ph.D. and Sherry Ruth Anderson, Ph.D. *The Cultural Creatives: How 50 Million People Are Changing the World*. New York: Harmony Books, 2000.
[63] Hartman Group. *The Hartman Report: Food and Environment: A Consumer's Perspective, Phase II*. (Prepared for the Food Alliance.) Winter 1997. See http://www.hartman-group.com/reports.html.
[64] Dr. Charles Benbrook, *Organic Foods Conference Proceedings*, University of Guelph, Ontario, Canada, January 31, 1998.
[65] Tom Monaghan. "Natural Foods Growing Fast." *Delaware Business News Journal*. July 6, 2002. Also see Organic Trade Services at http://www.organicts.com/index.html.

governmental organizations (NGOs) focused on environmental issues. Spurred by access to information and organizing capabilities using electronic mail and the Internet, groups are able to mobilize quickly to push for environmental improvements by industry and government.

TRENDS PROMOTING MORE WASTE AND MORE RISK

Despite improvements in resource productivity, pollution prevention, and risk reduction, there are powerful trends driving increased materials consumption and wastes. Even if countervailing trends succeed in significantly reducing the ecological footprint of each unit of output or consumption, unchecked increases in the total volume and frequency of products moving through the system can also pose significant challenges. While the individual ecological footprints may be smaller, the prospect of being trampled to death by a centipede is not desirable either.

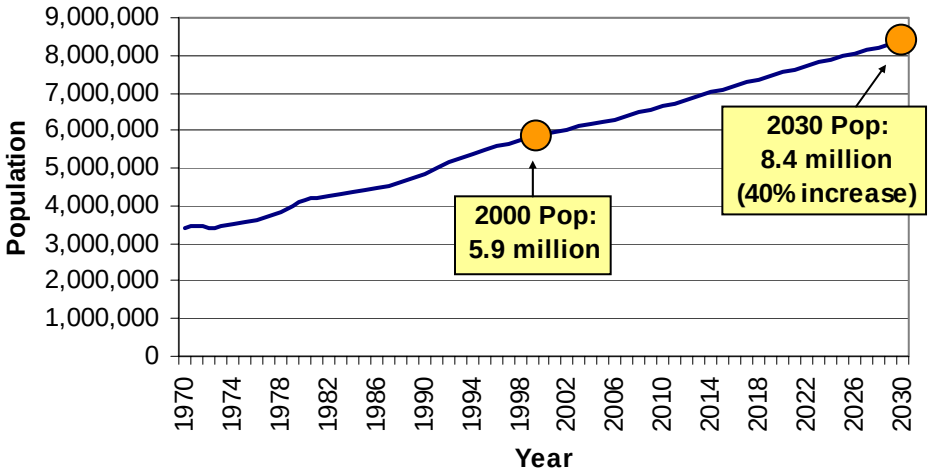
DEMOGRAPHIC CHANGE AND ECONOMIC GROWTH

Population and economic growth are both expected to increase in Washington State over the next 20 years. Increasing population and employment can have synergistic effects on the amount of waste produced by a state's economy. Beyond Waste Consultant Team Issue Paper 1 maintains that, as materials flow through an economy from raw material extraction to consumption, wastes are generated during each step of the process. Therefore, production within the state generates waste whether goods are exported to consumers outside its borders or used by residents. In-state consumption is directly related to the number of people living here. As population increases, the domestic demand for goods and their consumption increases, driving waste volumes higher as they are both produced and consumed locally.

Out-of-state demand for specific Washington goods and services increases production and employment. As the market demands certain goods or services from the state, workers are needed to create them. Incapable of fulfilling employment needs with current residents, employers encourage people to migrate to Washington State and work. Higher production increases wastes and new residents require additional goods and services for daily needs.

As shown in Figure 5, the Washington State Office of Financial Management (OFM) projects that the state's population will increase from 5,894,121 in 2000 to 6,648,112 in 2010, 7,545,269 in 2020 and 8,378,813 in 2030. The 12.8% increase in population by 2010 points to a probable increase in waste generation over that period.

Figure 5: Projected Population Growth in Washington State by 2030



OFM estimates that total Washington State non-agricultural employment will increase 13.9% from 2,709,246 in 2000 to 3,086,069 in 2010. This increase is projected to include substantial growth in the service, chemical and applied products, electrical and electronic equipment, and industrial machinery and equipment sectors. Large percentage losses in employment are anticipated in the primary metals and aerospace sectors.

PRESSURES FOR CONSUMPTION AND "CHURN"

While there are emerging trends such as "products of service" that can decouple material consumption from economic growth, powerful pressures remain focused on moving more goods faster through the economy (also referred to as "churn"). For many companies and industry sectors, profitability is a product of how many material goods are sold in a given time frame. Sophisticated marketing techniques are used to build consumer demand for new products. In diverse industries such as electronics, automobiles, and apparel, new products are continually introduced and entire product lines turn over in less than two years. For example, personal computers typically are replaced within two to five years. Most clothing companies introduce new product lines each season and change styles from year to year.

Consumer advocate Ralph Nader recently identified the "commercialization of childhood" as one of the more disturbing areas of corporate marketing aimed at increasing consumption.[66] He points to the numerous, tightly linked marketing messages that young children receive from television, videos, movies, toys, and consumer product packaging that reinforce consumptive behaviors. The desire to possess "the latest and greatest" and "new and improved" is instilled at an early age. While the drive to develop new product attributes and features can sometimes improve quality of life, critics counter that product innovations are more often designed to create demand for things that consumers do not need and do not measurably enhance quality of life.

[66] Interview with Ralph Nader. *The New York Times*. June 16, 2002.

TRENDS AFFECTING THE COMPOSITION OF MATERIAL AND WASTE FLOWS

As Washington State's economy diversifies, and its population base grows, the material flows and wastes that move through the economy are likely to change in composition. Experience from the past 20 years suggests that technically complex and composite products likely will continue to be a significant part of the waste stream in Washington (from a risk perspective, if not from a volume perspective). In addition, there likely will be new materials and wastes that will require careful attention and management. We encourage the Department of Ecology to remain observant of trends that may shift the composition of material and waste flows in Washington State, as well as trends that bring new information on the environmental and health risks of various materials and wastes to light.

THE RISE OF COMPLEX AND COMPOSITE PRODUCTS

Products made of multiple materials, often referred to as composites, are expected to continue as an important waste stream in Washington State. Composite products that incorporate hazardous substances (especially electronics) will continue to need vigilant management. Even composite products made of more environmentally benign materials are likely to pose management challenges, as disassembly for reuse or recycling can be difficult or expensive. High labor costs in the American economy make products that require significant human "touch" for recovery and recycling expensive to process. In addition, the material content of composite wastes frequently is not known. While certain plastics are labeled or coded, most constituent materials are not.

Discarded electronic equipment and components represent a prime type of composite waste that public agencies are struggling to manage. According to USEPA, discarded electronics represents approximately 1 percent to 2 percent of the waste stream in the U.S.[67] Electronic equipment and components often contain toxic materials, including lead, mercury, and cadmium. If mishandled, the disposal of these materials possibly can lead to contamination of groundwater, soil, and/or air. With the advent of new technologies such as digital television programming and flat screen televisions, the rapid evolution and greater affordability of widely-used technologies, and a strong reliance on electronic products for business and personal entertainment and communications, Washington State consumers' incentives and inducements to buy newer and more electronic products is expected to grow in the coming years. Therefore, careful management of these technically complex products will become even more important and imperative.[68]

NEW MATERIALS AND WASTE STREAMS

The introduction of new industries and products into Washington State also has potential to shift the composition of material and waste flows.

The rapid growth of the biotechnology sector in Washington provides an important example of how changes in the economy can affect material and waste flows. Medical and bioactive

[67] See http://www.epa.gov/epr/products/electronics.html

[68] Efforts to promote electronics recycling (through voluntary or mandatory manufacturer, retail, or government take-back programs) are building momentum in the U.S. Representative Mike Cooper (D, 21st District) recently introduced a bill to require manufacturers that sell electronics in Washington State to design and finance a reuse and recycling system statewide. At the national level, negotiations with the electronics industry are continuing into their third year. As a result, increases in generation of electronic wastes may be offset or "managed" by improvements in recycling and re-use rates.

wastes can pose different risks and require different management strategies than more conventional chemical hazardous wastes. Pharmaceutical wastes (often associated with biotechnology) have generated great interest in recent years and are the subject of continued research to better understand the synergistic and antagonistic adverse effects they may have when introduced to the environment.[69]

In addition, although companies are stepping up efforts to screen materials and chemicals for environmental and health risks, there are tens of thousands of chemicals and materials in use globally in products and manufacturing processes. Toxicological research continues to evolve, raising new questions and bringing new chemicals into the public policy spotlight. Emerging scientific research and public policy trends can signal the need to increase attention and vigilance on new (and existing) material and waste flows.

TRENDS AFFECTING GOVERNMENT LEADERSHIP IN PROMOTING BEYOND WASTE BEHAVIORS

Government environmental agencies at the federal, state, and local levels are demonstrating leadership in advancing elements of the Beyond Waste Vision. Such leadership is occurring in the regulatory arena as well as through other programs and initiatives.

Efforts to recycle nickel-cadmium (Ni-Cd) batteries provide a good example of how state leadership can influence industry actions. Ni-Cd batteries rely on cadmium to act as an electrode material and thus provide a power source for the battery. Cadmium is a toxic material and, if improperly disposed, can accumulate in the environment by leaching into ground water and surface water from landfills, and it can enter the atmosphere through incinerator smokestack emissions. In 1990, Minnesota passed a regulation requiring that rechargeable batteries be easily removable from products, be labeled as to content and proper disposal, and be banned from the municipal waste stream. In addition, the state called for manufacturers to take rechargeable batteries back at their own expense for recycling or proper disposal. Two years later, New Jersey passed similar legislation. These regulatory decisions spurred the development of a national recycling infrastructure. (The recycling technology had existed prior to 1990, but it was not widely implemented.) Then, in 1996, the Mercury Containing and Rechargeable Battery Management Act (P.L. 104-142) was signed into law by President Clinton, calling for national uniform labeling requirements for rechargeable batteries and products that contain them. The law mandates that rechargeable batteries (such as Ni-Cds) be easily removable from consumer products. While the federal law does not mandate take-back, it does eliminate barriers to encourage a voluntary system.[70]

More recently, California has pushed for reductions in carbon dioxide emissions from mobile sources. Meanwhile, nine states have banned mercury thermometers, and Connecticut recently enacted a ban on most mercury-containing products, exempting only certain lamps and pharmaceuticals. Maine requires auto manufacturers to take back and recycle automotive switches that contain mercury.[71] In addition to regulatory leadership, government can lead by

[69] See EPA's website "Pharmaceuticals and Personal Care Products as Environmental Pollutants" (http://www.epa.gov/nerlesd1/chemistry/pharma/) for additional discussion of this topic.
[70] For a history of Ni-Cd labeling and recycling efforts, see the INFORM Report, *Industry Program to Collect Nickel-Cadmium (Ni-Cd) Batteries*. http://www.informinc.org/battery.html
[71] http://janus.state.me.us/legis/ros/lom/lom120th/5pub651%2D700/pub651%2D700%2D05.htm

leveraging its own purchasing power and pursuing innovative partnerships and voluntary programs.[72]

TREND IMPLICATIONS FOR THE BEYOND WASTE VISION

The trends summarized in this section, among others, will pose opportunities and constraints for the State as it works to achieve the Beyond Waste Vision.

Trends driving less waste and less risk create opportunities. The State can seek to encourage and leverage some of these trends to achieve more improvement faster. For example, State efforts to encourage and facilitate industries' adoption of lean manufacturing and environmental management systems can leverage powerful, business-led, continual improvement-based systems for eliminating waste. Similarly, in a highly competitive business environment, altering certain price signals (e.g., waste disposal fees) can prompt behavior change as organizations seek to minimize costs and risk. The expanding definition of "customer" also opens new channels for applying pressure to particular economic actor sectors. For example, improving the transparency and availability of environmental quality and performance information can motivate NGOs and the public to agitate for change and performance improvement.

Trends also can impose constraints on the State's ability to act. Increased capital mobility limits the degree to which the State can alter price incentives using fees and taxes before businesses relocate to other jurisdictions or adjust investment decisions. High labor costs can increase the cost of implementing waste management programs, such as recycling, and other labor-intensive intervention tools. Sprawl can exacerbate efforts to collect and recover materials. The identification of new environmental and health risks, not to mention other budget priorities, can spread State resources thin for achieving Beyond Waste goals.

We encourage the State to remain observant of these (and other) trends in the years to come. As trends strengthen, dissipate, and emerge, new opportunities and new constraints for the State to achieve the Beyond Waste Vision will also arise.

5. Targeted Wastes and Economic Actor Sectors

The first issue paper in the Beyond Waste Consultant Team Issue Paper series, titled *Overview and Characterization of Material Flows and Wastes in Washington State*, identifies what wastes are generated and by whom. The waste characterization in Consultant Team Issue Paper 1 focuses on seven waste streams: solid waste, hazardous/dangerous waste, moderate risk waste, toxics release, biosolids, extraction wastes, and untracked flows. The paper examines the volumes of these wastes that each of ten economic actor sectors produce: residential, government, wholesale and retail, services and institutions, manufacturing and industry, energy production, mining, forestry, and agriculture.

Although a wealth of additional detail about this analysis is presented in Consultant Team Issue Paper 1, the two figures below provide a visual display of each economic actor sector's relative generation. Black cells indicate relatively large waste generation, while white cells indicate relatively small waste generation. Figure 6 shows each sector's relative generation of the seven

[72] Examples include EPA's sector-based initiatives, Oregon's Green Permits Program, and numerous federal and state environmental purchasing initiatives (see http://www.gpp.org).

waste streams, while Figure 7 shows each sector's relative generation of four material types: organics, technical materials, toxics, and hazardous chemicals.

Figure 6: Economic Actor Sectors' Relative Generation of Seven Waste Types

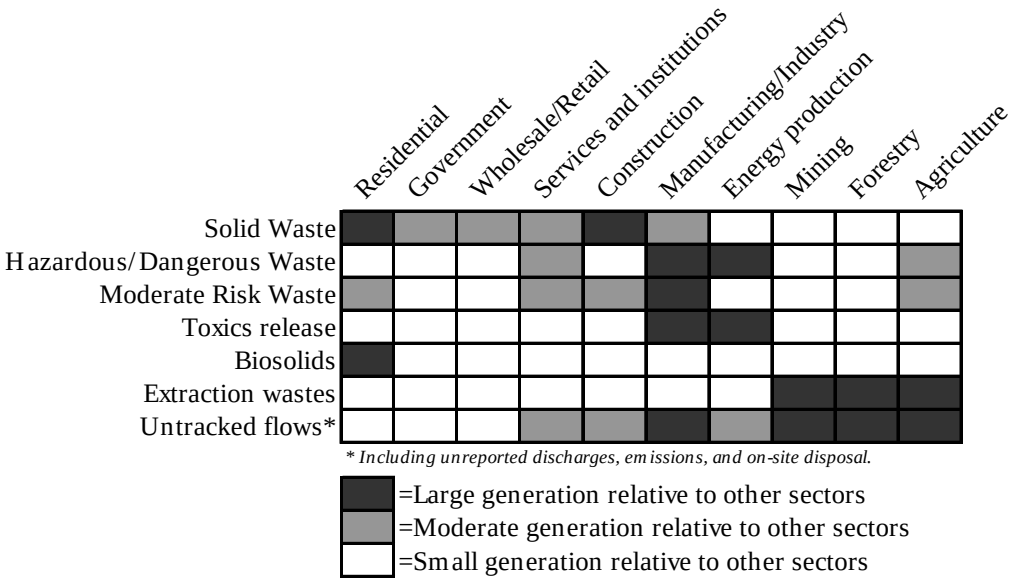
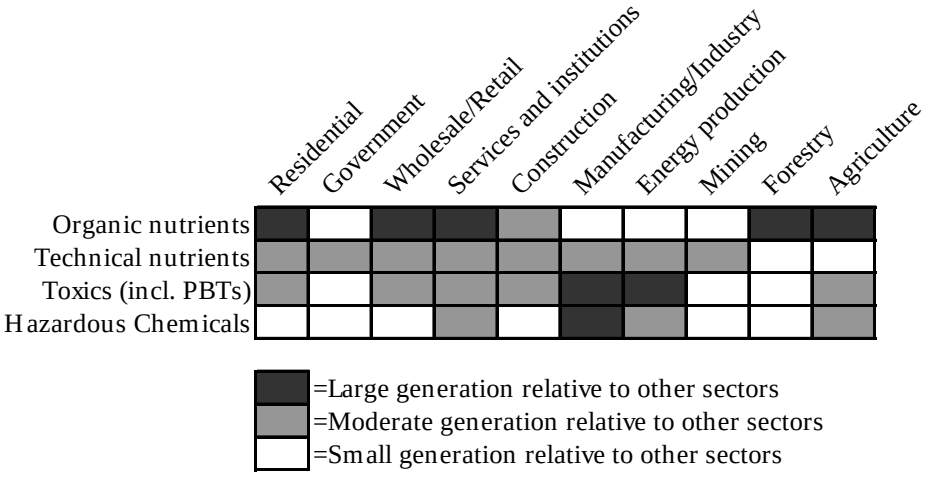


Figure 7: Economic Actor Sectors' Relative Generation of Four Material Types



The figures above indicate where wastes of high volume are generated. In particular, the above information shows that:

- **Some wastes are generated in large quantities by numerous economic actor sectors.** The solid waste generated by most sectors consists of a high degree (about 40 percent) of organic materials, such as food, leaves, grass, prunings, and compostable

paper. Additionally, common technical materials, such as glass, plastic, metal, and recyclable paper, comprise another 40 percent of most solid waste.[73]

- **Many toxic materials, including persistent bio-accumulative toxins (PBT), are consumed and/or generated in moderate quantities by numerous economic actor sectors.** The presence of these toxics dispersed throughout the economy and in the environment suggests the need for special vigilance. A desired outcome of the Beyond Waste Vision is to eliminate the production and use of these materials.
- **Other wastes are concentrated in only a few economic actor sectors.** For example, hazardous chemicals are generated largely by the manufacturing and industrial sectors.
- **The volumes and potential hazards associated with many untracked flows are not well known.** Many of these untracked flows are associated with specific economic actor sectors.

This chapter expands upon these points and examines the economic actor sectors that are appropriate for further investigation in the Beyond Waste study.

TARGET ECONOMIC ACTOR SECTORS

The information in the figures above provides a partial construct for selecting economic actor sectors for initial Beyond Waste consideration. In addition, the consultant team considered the economic actor sectors that, because of their placement in the economy, can influence their critical customers to achieve greater change. Based on the consultant team's research, the following economic actor sectors emerged as promising ones for further investigation.

1. Construction. The construction sector (which includes demolition) is a clear choice for initial attention because of the following points:

- **The construction sector generates about one-quarter of the solid waste disposed in Washington each year.[74]** As indicated in Figure 6, this proportion is relatively large compared to the waste generated by other sectors.
- **The construction sector also uses large quantities of raw materials to construct the tens of thousands of residential and commercial buildings constructed annually.**
- **Trends are already emerging in the construction sector that may facilitate change.** For example, more building products with recycled content are emerging (e.g., recycled plastic/wood siding), and several local governments and businesses have been focusing on developing infrastructure for recycling construction and demolition debris. In addition, local and national initiatives are starting to bring environmentally conscious building practices into the mainstream.
- **Buildings of the future have not yet been built.** By influencing design and growth practices now, the State can have a great effect on future waste generation and environmental impacts of the built environment.

The State may be able to build on these existing trends to reduce waste dramatically in the construction sector, and increase demand for recycled-content materials as well as raw materials that are extracted sustainably. Also, since the infrastructure of the built

[73] Based on recent studies in King County by Cascadia Consulting Group.
[74] According to modeling estimates by Cascadia Consulting Group, the construction sector (including demolition) disposed nearly 1.7 million tons of solid waste in 2000. This is 23% of the estimated total 7.1 million tons of waste disposed.

environment is so long lasting and has so many implications for long-term energy and material consumption, changes in design and building practices now could have huge Beyond Waste payoffs 25-50 years into the future.

2. Industrial The industrial sector merits continued focus for Beyond Waste targeting because of the following observations:

- **The industrial sector makes a significant contribution to the production of hazardous waste in Washington State and is a moderate producer of solid waste.**[75] Additionally, the consultant team's projections indicate that the industrial sector will continue to be a dominant generator of hazardous and dangerous wastes over the next decade.
- **The industrial sector has an influential role in deciding what materials and processes are used to make products.** The industrial sector's influence over production leads to an indirect yet tangible effect on the distribution and consumption of goods in Washington State. With multiple points of contact to the economic process, the industrial sector makes key decisions that affect material and waste flows and is susceptible to the influence of many critical customers and a variety of behavior-changing tools and strategies.
- **Finally, Washington's environmental regulatory environment establishes a close relationship between the industrial sector and Ecology.** Current efforts to align regulatory and programmatic efforts to facilitate beyond-compliance behavior present an excellent foundation on which to leverage the industrial sector towards Beyond Waste.

3. Residential The consultant team has identified the residential sector as an important initial focus for the following reasons:

- **As the end-users and consumers of most products and services, residential consumption plays a large role in driving material flows and waste generation in the state**. In fact, overall solid waste generation correlates more closely with consumer spending than with any other single variable, including population.[76]
- **The residential sector disposes of a relatively large quantity of solid waste,** as displayed in Figure 6.**[77]**

Ecology and local governments have already focused substantial resources on reducing waste in the residential sector. Because so much waste is still generated, and because of the opportunity to use consumer demand as a pressure on producers and retailers, the residential sector stands out as another clear area for Beyond Waste attention.

4. Wholesale/Retail. The wholesale and retail trades generate moderately large quantities of solid waste. Closely linked to the residential sector, the wholesale/retail sector stands out because of the following points:

- **The trades dispose large quantities of packaging wastes, as well as defective or spoiled products,** including large quantities of food from grocery stores.[78] These wastes could be targets for waste reduction, recycling, or composting.

[75] During 2000, 99,814 tons of primary, recurrent, non-wastewater, and non-mixed radioactive wastes were generated by the industrial sector in Washington State.
[76] Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: EPA Office of Solid Waste and Emergency Response, June 2002.
[77] According to modeling estimates by Cascadia Consulting, the residential sector disposed an estimated 2.4 million tons of waste in 2000, or about one-third of all solid waste disposed.

- **The wholesale and retail sector influences product consumption in the residential sector and product design in the manufacturing/industrial sector.** This influence possibly extends to initiating increased packaging efficiency and/or reduction of toxics and hazardous chemicals in products.
- **As retailers become increasingly consolidated into large, well-known chain stores, the State may have the opportunity to influence material consumption and toxicity dramatically in the wholesale and retail trades.** By focusing on only the handful of leading businesses that control a large percentage of the supply chain, the State may be able to effect broader change throughout the economy.

TARGET MATERIAL FLOWS AND WASTE STREAMS

The above economic actor sectors are strong starting points for Beyond Waste efforts. Some waste or material types, however, are generated consistently by most economic actor sectors. Two material types stand out in terms of the large quantity generated by many different sectors and the potential value associated with their reuse or avoided disposal. Several other materials are generated in large quantities, or in sufficient amounts that they pose risks to human or environmental health.

1. **Hazardous wastes and materials.** A key element of the State's Beyond Waste Vision is to lower the toxicity of materials and wastes flowing through Washington State. Hazardous substances, and hazardous and toxic wastes (including PBT) require vigilant management efforts to ensure that their production, handling, use, reclamation, and disposal occur within the bounds of currently accepted environmental and human health risk. This need for vigilance leads to relatively expensive and complex management efforts and an elaborate and expensive compliance assurance infrastructure. Public and private resources that could be spent on other programs are expended on vigilance programs, lowering state competitiveness. Hazardous waste forecasts indicate that, despite material use efficiencies, the volume of hazardous waste generation in 2010 will be comparable to current levels. Targeting hazardous substance use can lead to lower toxicity "downstream," as production processes generate less waste and products are used and disposed. This target provides an opportunity to build on Ecology's current efforts to eliminate PBT and other toxics while increasing the State's ability to thrive economically and maintain or improve the quality of life in Washington State.
2. **Technical nutrients.** Over the last two decades, Ecology has devoted significant resources to establishing recycling programs. These programs have focused especially on technical materials, such as glass, plastic, metal, and paper. However, significant quantities of these materials still are disposed in the waste stream, where they comprise up to 40 percent of the waste. In creating a plan for Beyond Waste, Ecology has the opportunity to build on its existing work with technical nutrients to collect more materials and create continuous cycles of technical nutrients with minimal down-cycling into lower-value products.
3. **Organics.** Food, leaves, grass, pruning wastes, food-soiled paper, and clean wood together comprise over 40 percent of municipal solid waste from both residential and commercial sources. Once collected, these materials can all be composted to create a beneficial product used as a soil amendment or mulch in landscaping and agricultural applications. In addition, large quantities of biosolids and agricultural wastes are generated, all of which can be returned to productive use as compost. Ecology, local governments, and

[78] According to the 1992 Washington State Waste Characterization Study and more recent studies completed in California by Cascadia Consulting.

businesses have all been increasing their attention on practical means of reclaiming these organic materials from the waste stream for productive use. Because organics represent such a large share of the waste stream, and because initial efforts have been largely successful, a focus on organics should continue to yield Beyond Waste dividends. In Beyond Waste planning, an opportunity remains to develop compost infrastructure and markets to create a fully functioning organics cycle.

Please note that the target wastes and sectors proposed in this paper were chosen based on an analysis of opportunities and concerns associated with each waste flow, based on available but limited information. As such, they target flows that are large or require vigilant management. While they do not target all wastes, the sectors and wastes listed above represent most of the tracked hazardous and non-hazardous wastes in Washington.

6. Leverage Points and Tools

This chapter explains the concept of leverage points in more detail, and describes the range of tools available to the State to affect the leverage points. The centerpiece of this chapter is Table 2, the tools matrix, which provides insight into the potential benefits from and challenges to implementing the tools. However, because of the size of the matrix, it is included in this document as Appendix B.

LEVERAGE POINTS

A leverage point is a place where a policy tool has the ability to affect an economic actor sector's waste or material decision and ultimately leverage broader change. A useful analogy for considering leverage points is the concept of the trimtab. A trimtab is a small flap on the back of the rudder of a plane or ocean vessel that applies a small amount of energy to move the rudder, which in turn, alters the course of the vessel. The trimtab is able to exert substantial change by applying energy and pressure strategically to leverage broader change.

Similarly, the State should look for places to apply energy and resources to build the maximum momentum and progress toward the Beyond Waste Vision. These leverage points reside at economic actor sectors' decision points, and at the points where critical customers influence economic actor sectors' behaviors. For example, a key decision point in the building process is the initial decision to create a building. The State can influence the economic actor sector – the developer – such that he or she chooses to build a green building. As a result, a raft of Beyond Waste behaviors will occur, including waste reduction in the design of the building, selection of non-toxic or sustainable building materials, and perhaps even salvage from any pre-existing buildings on the site. Alternatively, the State could choose to influence the developer's most critical customer – the building owner. If the building owner demands a green building, the developer will provide it, and the same benefits will result. In both cases, the State would have maximized the use of its resources because a wide range of Beyond Waste behaviors would result from changing, or leveraging, one decision rather than many.

The previous chapter identified a number of targeted economic actor sectors. The following table provides a preliminary assessment of the key decisions and critical customers that likely affect their waste generation.

Table 1: Key Decisions and Critical Customers for the Targeted Economic Actor Sectors

Economic Actor Sector	Decision affecting waste	Critical Customers
Construction	▪ Building/structure design ▪ Choice of building materials ▪ On-site re-use/waste minimization practices ▪ How to dispose unused or waste materials	Building owners, financiers, permitting agencies and inspectors, state and local government, real estate brokers, tenants, site neighbors, community
Manufacturers/Industry/ Energy	▪ What product to make ▪ How to design the product ▪ What raw materials to use ▪ How to manufacture products ▪ How to treat emissions/discharges	Investors, landowners, transportation providers, material suppliers, equipment manufacturers, government regulators, wholesale/retail, consumers, waste users

	▪ How to dispose of byproducts and wastes	
Wholesale/Retail	▪ How to market products ▪ How to package products ▪ How to manage waste	Manufacturers, parent companies, consumers/residents, transportation providers, investors, government, community
Residential	▪ What products to purchase ▪ How to dispose of them when no longer needed	Self (ego), friends, peers, family, neighbors, colleagues, employers, community

These decision points represent likely leverage points. Before selecting a leverage point for action, however, the State should consider whether an opportunity exists for action, and whether the possible leverage point seems ripe for action. Decision points where the State has some influence are more likely to be strong leverage points than others. For example, state government is a critical customer of the building industry, because the state funds construction of buildings to house its staff and elected officials. As a result of its status as a state agency, Ecology should be able to influence this critical customer's construction decision such that it demands green buildings. This decision point also is ripe: the Legislature appointed a Joint Task Force on Green Building in 2002 to investigate adopting green building practices for the State of Washington. Therefore, this leverage point is a strong candidate for action to move the state closer to the Beyond Waste Vision.

Decision points where the State has less influence are weaker opportunities for action, but should not be dismissed entirely, especially if the possible leverage point seems ripe for action. In such a case, the State should seek to form strategic partnerships to improve the chances that its actions will influence the economic actor sector or critical customer in an effective and efficient manner.

Once the State has identified leverage points, it must select the proper policy tools to apply to them. The next section describes the range of tools available to the State.

TOOLS

The consultant team created a Tools Matrix to organize the multitude of available tools into discrete groups that work in similar ways to influence the behaviors of economic actor sectors and critical customers. Although some of the tools could be placed into any of several categories, they are each listed only one time. Because of the size of the matrix, it is included in this document as Appendix B. The tool categories are described briefly below.

- **Economic Incentives**—Tools that influence the financial gains or losses associated with current or future behavior. Increasing the financial attractiveness of behavior through mechanisms such as subsidies can encourage desirable activities. Conversely, increasing the costs of a behavior through taxes or other means can discourage undesirable behaviors. These tools, along with fees and rate structuring, also are known as price signals.
- **Fees & Rate Structuring**—Tools that adjust the explicit costs of behaviors to discourage waste generation. Examples include increasing tipping fees for dumping waste in a landfill or establishing tax credits to encourage recycling.
- **Market Creation**—Tools that strengthen or establish markets that reward the adoption of environmentally beneficial behaviors. Using such tools, environmental improvements (reducing pollution) or maintaining healthy ecosystems (land conservation) can be rewarded with resource flows from other parties.

- **Regulation/Legislative Requirements**—Tools that proscribe the behaviors that individuals and organizations are obligated by law or rule to practice. Failure to stay within the accepted boundaries of the requirement(s) opens a party to enforcement risks.
- **Enforcement & Liability**—Tools that discourage behaviors considered undesirable by either legislated or common law. These strategies make clear (in a timely fashion) the consequences of engaging in undesirable behaviors.
- **Informed Consumer Choice**—Tools that provide consumers with information about the ramifications of purchasing goods from individual entities. This information allows consumers to consider the product and/or the processes used to create it when making purchasing decisions. These tools create opportunities for consumers to "reward" good (corporate) environmental behavior with their pocketbooks.
- **Technical Assistance & Tool Provision**—Tools that create and disseminate information on best practices to give organizations new information and skills to better evaluate and shape their behavior. Pollution Prevention (P2) site visits are one well-known example.
- **Government Leadership/Lead by Example**—Tools that demonstrate the benefits of adopting new environmentally beneficial behaviors through government adoption prior to widespread adoption by the rest of the economy. Pilot projects and green purchasing initiatives are two common examples.
- **Education, Outreach, and Promotion**—Tools that expand the breadth and depth of knowledge about specific environmental issues that a community currently faces. These tools can help residents and businesses become aware of existing waste reduction or recycling opportunities or practices. Examples include outreach programs and public service announcements.

As mentioned above, some of the tools in the matrix could be placed into multiple categories. This characteristic is particularly true of potential voluntary initiatives that economic actor sectors undertake as well as voluntary partnerships between economic actors and regulators. Examples include product stewardship, product take-back programs, performance recognition partnerships (e.g., EPA's 33/50 program), regulatory responsiveness programs (e.g., EPA Performance Track), and performance/process disclosure. Voluntary programs and tools can encounter significantly less political opposition than required programs, although the rate of participation in voluntary initiatives is likely to be significantly less than that for required programs. A separate category was not created for voluntary tools in this matrix. The State, however, should keep in mind that this is an important dimension that will alter both the effect of the tool as well as its political feasibility.

The matrix is structured to provide information needed to assess the individual tools qualitatively and to judge their ability to individually encourage Beyond Waste behaviors throughout the Washington State economy. The matrix includes the following information for each tool:

- Name;
- A brief description;
- Examples of where the tool has been applied (where available);
- Likely waste or material flow(s) targeted;
- Likely economic actor sector(s) targeted;
- The potential benefits from implementing the tool; and
- Challenges to implementing the tool.

All of these categories are descriptive only. The matrix contains no ratings or assessments of the tools, because the effectiveness of a tool is likely to change depending upon the circumstances in which it is applied. Instead, the categories are intended to give the State some insight into each tool and its application.

SELECTING TOOLS FOR IMPLEMENTING THE BEYOND WASTE VISION

At its foundation, the Beyond Waste Vision is a paradigm shift that requires an integrated and opportunistic approach to gain the support of state agencies, the public, and the legislature. Therefore, the State needs both measurable short-term successes and a long-term plan that will build momentum for additional activities. In this context, tools should be selected in light of current conditions and future trends affecting waste, possible synergies created by combining and sequencing several tools, and emerging opportunities to move forward quickly and successfully.

The potential benefits from and challenges of implementing a tool can vary significantly according to the specific circumstances of its deployment. Additional factors, such as those listed below, should be considered to develop an effective "portfolio" of tools to help move toward the Beyond Waste Vision:

- The relative risk/importance, or need for vigilance, associated with a particular material or waste flow;
- The potential for synergies created by combining and/or sequencing tools;
- The potential for a tool to raise awareness or result in broader or more systemic behavior change within an economic actor sector;
- The potential for the tool to result in measurable short-term improvements that can build momentum to pursue additional activities;
- The emergence of key trends that create a window of opportunity for pursuing a new Beyond Waste tool. Windows of opportunity are typically created by major changes such as changes in public opinion stemming from perceived crises, decisions about making major capital investments, introduction of new technologies, or the development of new laws, regulations, and budgets; and
- The potential to partner with other states, organizations, institutions, and government agencies to align programs and incentives and reinforce desired behavior changes.

Most importantly, the State should seek to identify tools that can be applied effectively to leverage points, in order to use scarce resources to foster widespread change. When promising tools synchronize with conditions, trends, and opportunities, a leverage point exists. We believe that these leverage points offer the best avenues to move toward the Beyond Waste Vision.

The next chapter synthesizes the information on trends, leverage points, and tools presented in chapters 3 through 6 into seven initiatives that are considered to be strong starting points for action toward the Beyond Waste Vision.

7. Initiatives

The purpose of the consultant team's analysis to this point has been to examine the Washington waste system and to identify likely areas for the State to target for early action toward the Beyond Waste Vision. The waste generation and trends sections set the stage for this analysis, allowing us to identify economic actor sectors and waste flows that warrant further investigation. The identification of leverage points and a range of tools to apply to them further strengthens this analysis.

In this section, we present seven initiatives that are the ultimate result of this analysis. These initiatives represent robust areas for focused action, based upon our assessment of the importance of the wastes the generate, the trends that are influencing them, the economic actor sectors that operate upon them, and the leverage points and tools that are available to the State to shift them.

However, these initiatives are not intended to address all waste flows and all economic actor sectors in the state. They focus instead on wastes that are of concern due to their volumes, adverse effects on the environment or human health, or both. In addition, they represent viable starting points because each encompasses a variety of leverage points where the State can work to create change.

The initiatives are designed to eliminate waste by (1) creating viable return flow cycles, (2) minimizing the generation of waste as a by-product of economic activity, (3) reducing the material intensity of products and processes and/or (4) reducing the use of toxic or potentially toxic materials as inputs. These initiatives are recommended as potential initial building blocks for achieving the Beyond Waste Vision.[79]

INITIATIVES TARGETING SPECIFIC ECONOMIC ACTOR SECTORS

The four initiatives presented below target specific economic actor sectors as the entry point for Beyond Waste action and involve a variety of different tools and strategies to change behaviors associated with the leverage points. These initiatives use incentives, market forces, procurement policies, and other tools to change inputs, designs, processes, products, and consumer behaviors so that over time the economic actor sectors will eliminate most solid and hazardous wastes. More detail on each of these initiatives, including preliminary tools and target wastes for each economic actor sector, are included as Appendix C.

1. **Encourage a green built environment.** This initiative seeks to "green" the construction industry by focusing on the leverage points available as the building industry designs and chooses raw materials, designs and builds structures, and makes decisions about how to manage wastes. The goal of this initiative is to reduce construction waste, employ substitutes for hazardous materials, use wastes as raw materials, and decrease the use of virgin resources. This initiative has the opportunity to build on existing changes and pressures in the industry, including local, regional, and national green building programs; changing economics of virgin raw materials versus alternative, recycled, or composite

[79] Other potential starting points exist, and in fact, Ecology already is pursuing several of them. For example, Ecology is addressing PBTs and obsolete electronics, two excellent starting points for action toward the Beyond Waste Vision. The seven initiatives described in this section were selected because they complement, rather than duplicate, Ecology's current efforts.

products; and increasing acceptance in the marketplace of recycled building materials and green design practices.

2. **Eliminate wastes and hazardous/toxic substances from industry**. This initiative seeks to alter waste generation and use of hazardous substances in industry dramatically by affecting the manufacturing and industrial sector's choice of raw and packaging materials, design of products, and management of byproducts.
3. **Reduce material consumption and toxicity in the wholesale/retail trade**. This initiative seeks to reduce packaging waste from the wholesale and retail trades, and create incentives for the trades to help influence the manufacturing and residential (consumer) sectors. Key targeted leverage points include the wholesale and retail trades' effect on the purchase of consumer goods, and the trades' packaging choices.
4. **Reduce material consumption and toxicity in the residential sector**. Closely linked to the previous item, this initiative targets the purchase of goods from the consumer demand side. It also targets the leverage point available as residents choose to dispose of goods, with the goal of entering unusable products into the organics and technical nutrient cycles.

RETURN FLOW CYCLE INITIATIVES

In addition to the initiatives discussed above, another fundamental component of a successful Beyond Waste Plan will be establishing economically viable return flow cycles. While strategies to minimize the generation of wastes through design, process efficiencies, and changes in consumer behavior certainly will have a significant impact on material flows, it will still be essential to create healthy systems to recover, reprocess and then reuse what society now considers waste. Many successful return flow cycles are already in place, such as recycling of cardboard, aluminum, metals, and some plastics. To achieve the Beyond Waste Vision, new systems that can recover a wider range of materials efficiently for reuse with a minimum of down-cycling will need to be established. Viable return flow cycles will require such actions as changes in product design, pricing incentives, and new investments in collection and processing infrastructure.

The consultant team recommends that the State make establishing such viable return flow cycles a high priority in its Beyond Waste Plan. While Ecology cannot necessarily influence all the decisions related to the return flow cycle, it still has the ability to affect important elements of the process. We recommend that Ecology focus first on creating return flow cycles for organic materials and technical nutrients found in the MSW stream. The initiatives to create these return flows are summarized below.

5. **Establish a viable organics cycle**. This initiative targets three key leverage points to capture compostable organic materials from the waste stream and return them to productive use as fertilizers and soil amendments: 1) the disposal of organic goods and materials by all sectors; 2) the process of growing agricultural and forest commodities, and 3) the purchase of consumer and agricultural goods such as pesticides and fertilizers. In addition to capturing organic material from the waste stream, the goal of this initiative is to use organic inputs in place of chemicals on residential, agricultural, and forestry lands.
6. **Create a technical nutrient cycle.** The goal of this initiative is to keep technical materials continuously cycling in the economy while minimizing down-cycling into lower-value products. Like the organics cycles, this initiative uses the leverage points available as consumer goods are disposed and purchased. Additionally, applying tools to leverage product design practices and choice of raw materials will be important to facilitate the recovery of technical materials into closed-loop cycles.

PRICE SIGNALS INITIATIVE

Finally, strategies to achieve the Beyond Waste Vision will need to shift consumer, business, and industry material and product choices to those consistent with the Vision. Such efforts should discourage the use of toxic materials and virgin resources and encourage the use of safe, recycled, environmentally preferable materials and products. The consultant's final proposed initiative is to use pricing, fees, and green tax strategies to affect waste and material choices.

7. **Align price signals for Beyond Waste behavior.** The goal of this initiative is to align fees, taxes, and price signals to provide incentives for Beyond Waste behavior. All economic actor sectors consider economics in their decisions, and by systematically and consistently influencing these decisions, the State can leverage broader change. Given these potential impacts across leverage points, economic actor sectors, and materials, the consultant team believes that aligning price signals is a fundamental component of a successful Beyond Waste Action Plan. The challenge will be acquiring resources and gaining support despite initial stakeholder opposition.

TARGETED MATERIAL FLOWS AND WASTE STREAMS

The above initiatives, if fully implemented, would substantially achieve the Beyond Waste Vision. They are logical starting points for Beyond Waste efforts as they make use of existing leverage points and target flows that are worth addressing. Of course, periodic re-assessment will be needed, but these initiatives make sense given our current understanding. The following table describes the quantity of waste targeted by each initiative. While it is tempting to favor the initiative that targets the largest quantity of waste, in practice the initiatives would be highly linked, and the estimated impact of each would not necessarily be realized without the others. Note that combined, the seven initiatives would target 80% of the tracked waste in Washington.

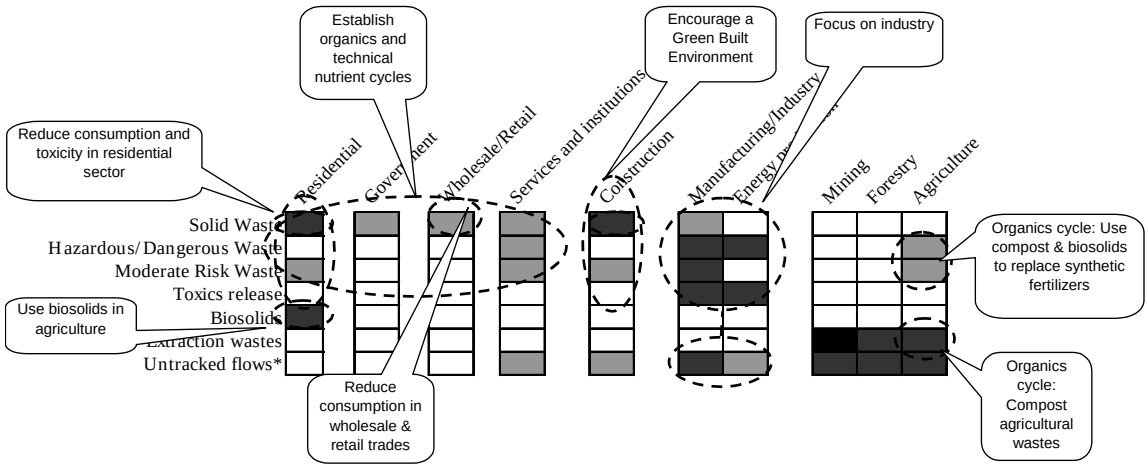
Table 2: Solid and Hazardous Wastes Targeted by the Proposed Initiatives[80]

Initiative	Solid Waste Goal/Target	Hazardous Waste Goal/Target
1. Built Environment	1.0 million tons of C&D material diverted (not including clean wood, which is included above in organics cycle)	New construction materials are safe, and arsenic-treated wood and other existing hazardous substances are managed with vigilance
2. Industry	0.5 million tons of industrial wastes diverted	Over 100,000 tons hazardous wastes eliminated Nearly 16,000 toxic substances eliminated
3. Wholesale/retail	0.4 million tons of packaging waste eliminated	Wholesale/retail sector becomes an advocate for efficient, effective, toxic-free products
4. Residential	Organic and technical nutrients diverted, figures included in above initiative	Households demand toxic-free products
5. Organics Cycle	2.2 million tons of material composted	Hazardous chemicals and toxic substances eliminated in compostables
6. Technical Cycle	1.7 million tons of material entered into closed-loop technical cycles	Some process chemicals become products of service, used as technical nutrients
7. Price Incentives	Encourage reduced use of virgin materials and increased recovery of material into organics and technical cycles	Elimination of toxic substances because their use is not cost-effective
Entire Package	**5.8 million tons of solid waste eliminated (about 80%)**	**Most hazardous chemicals and toxic substances eliminated**

Figure 6 (Chapter 5) estimated each economic actor sector's relative waste generation. At this point, it also provides a convenient method of determining how the proposed initiatives address key wastes. Figure 8 revisits the previous figure and shows the wastes and economic actor sectors that each initiative targets.

[80] The solid waste goals listed in this table were calculated based on modeling conducted by Cascadia Consulting Group. Data sources include Solid Waste in Washington State: Tenth Annual Status Report, the 1992 Washington State Waste Characterization Study, and studies on waste generation by economic sector completed in California by Cascadia Consulting Group, including the Statewide Waste Characterization Study and a study of waste by commercial sector in Los Angeles.

Figure 8: Wastes and Economic Actor Sectors Targeted by the Proposed Initiatives



As shown above, the proposed initiatives address the major waste streams in Washington. Note that extraction wastes from mining and forestry, as well as many untracked flows, are not specifically addressed. As discussed in Beyond Waste Consultant Team Issue Paper 1, the consultant team recommends further assessment of these flows before initiatives and strategies are developed for them. The initiatives proposed in this memo address flows and wastes that are largely already within Ecology's mandate, are generated in large or high-risk quantities, and in which focused attention could build on existing work and trends to accomplish early successes.

Although these seven initiatives add up to a powerful package of actions, it is not possible for Ecology to begin work on all of them at this time. The final chapter in this paper explains how Ecology and the consultant team chose to focus on three of these initiatives for in-depth research and development of action plans to implement them in the near-term.

8. Moving Toward Beyond Waste

Chapter 7 outlines seven initiatives that the State could pursue to begin to achieve the Beyond Waste Vision in Washington. However, as Chapter 7 also states, undertaking all seven initiatives simultaneously would tax Ecology's resources, as well as those of its partners and customers. Therefore, Ecology and the consultant team selected three initiatives for further research. This chapter describes the criteria that were used in making these selections, the general format for the in-depth research, and the principles that the consultants used to develop action plans for each initiative.

INITIATIVE SELECTION

On October 2, 2002, the consultant team met with the Beyond Waste Steering Committee to discuss the seven initiatives and to select a few for further research. The group agreed upon a number of criteria, including the following:

- The significance of the waste stream
- Opportunities to create value
- Availability of leverage points
- Ease of implementation, both politically and technically
- Potential for early success to build momentum
- Cost-effectiveness
- Responsiveness to stakeholder interests
- Complementary to Ecology expertise
- Existence of performance measures

As a result of this meeting and subsequent discussions with Ecology, the group decided that the consultant team should focus upon three initiatives for further research:

- **Initiative #1, Encourage a green built environment in Washington State.** This initiative was chosen because construction and demolition debris represents a quarter of the solid waste generated in Washington State annually, and momentum is building within the industry itself toward green building practices.
- **Initiative #2, Eliminate waste and hazardous/toxic substances in the industrial sector.** The group selected this initiative for three reasons: the industrial sector generates the majority of reported hazardous waste in Washington State, has a history of working with Ecology, and is trending toward eliminating wastes to increase competitiveness.
- **Initiative #5, Establish a viable organics return flow cycle.** Like construction and demolition, food and yard wastes also constitute one quarter of solid waste generated in Washington annually. In addition, a number of trends, such as the development of alternative energy sources and the increasing market for organic agriculture, make diverting organic matter from the waste stream more attractive and provide leverage points.

These three initiatives represent target waste streams that are large and/or contain wastes that require vigilant management. However, as the trends described above indicate, they also target waste streams in which movement toward Beyond Waste behaviors is occurring already. As a result, these initiatives represent opportunities for success that can help build momentum toward Beyond Waste and serve as models for Beyond Waste behavior.

The consultant team agreed to research policy issues and strategies as well as specific approaches to implementation, ultimately creating an Action Plan for each initiative. This research approach allows Ecology to understand both the policy issues and the mechanics of moving forward with the central aspects of achieving the Beyond Waste Vision – eliminating waste through reduced material intensity and creating return flow cycles.

The results of the research into these initiatives are presented in Beyond Waste Consultant Team Issue Papers 3-5.[81] Issue Paper 3 addresses waste reduction and toxics use in the industrial sector, Issue Paper 4 discusses establishing an organics return flow cycle, and Issue Paper 5 describes ways to encourage the spread of green building practices in Washington. Each paper identifies the economic actor sectors, critical customers, leverage points, and barriers that are critical to developing strategies to foster Beyond Waste behaviors. The papers also describe the current waste generation and management strategies common today in each initiative, and the changes that are necessary to achieve the Beyond Waste Vision. Each paper concludes with an Action Plan that is aggressive but achievable if the State commits to bold and coordinated action.

PRINCIPLES FOR DEVELOPING ACTION PLANS

A series of principles emerged from the consultant team's research into the three initiatives, and shaped our thinking and recommendations about effective and realistic strategies for moving toward the Beyond Waste Vision. The concepts below aim to alter the status quo and to tap the factors that enable successful change.

1. **Clear articulation of desired behaviors, outcomes, and benefits establishes a foundation for concerted action.** Economic actor sectors and critical customers will want to know "what do I need to do differently to help achieve the Beyond Waste Vision?" A clear articulation of the behaviors and outcomes needed to achieve the Beyond Waste Vision can provide an essential benchmark for focusing both private-sector actions and government activities. Economic actor sectors also will need to assess the business case for moving toward the Beyond Waste Vision. Improved understanding of the business and technological constraints that bind economic actor sectors' behaviors can spur creative approaches for strengthening the business case for action toward the Beyond Waste Vision.
2. **Signals are more powerful when aligned and linked.** The State can play an important role in encouraging and facilitating beyond compliance behavior among economic actor sectors in Washington. State government "touches" the private sector in numerous ways – through regulation, permitting, inspections, procurement, information collection and sharing, technical assistance, fees and taxes, among others. By aligning all of the ways in which government "touches" economic actor sectors to demonstrate responsiveness to Beyond Waste environmental performance and behaviors, the State

[81] Issue Paper 6: Potential Enhancements to Ecology's Pollution Prevention Planning Program, was developed under a separate task of the consultant team's scope of work and does not cover one of the initiatives. Instead, as its title implies, the paper offers a number of strategies to increase pollution prevention planning to help achieve the Beyond Waste Vision.

can encourage further progress by expanding the business case for change. No one policy tool is likely to provide a silver bullet for reaching the Beyond Waste Vision, but a well-aligned system of policy tools can ensure that all government "touch points" focused on the economic actor sector are pushing in the same direction and sending strong signals about the benefits to individuals, firms and the Washington economy of moving toward the Beyond Waste Vision.

3. **Continual incremental improvement is essential for achieving bold change.** While it can be enticing to respond to a bold vision with swift and bold action, windows of opportunity for bursts of bold action are often few and far between. Yet focused, continual incremental improvement is often underrated for its ability to bring about transformative change. Phased, continual improvement approaches give organizations certainty about future directions, while providing time for industrial sector adaptation. Adaptive management strategies enable government agencies to learn while implementing, and to adjust further action to capitalize on opportunities and to mitigate constraints. In the absence of powerful drivers, bold bursts of action into untested areas frequently become mired in political controversy, which can paralyze even modest progress on related fronts. This characteristic does not mean that there is no place for bold bursts of action. In many cases, the information and feedback generated by incremental improvement efforts often create windows of opportunity for aggressive improvement and accelerate the justification for bolder bursts of action.[82]

4. **Collaborative efforts and creative partnerships are key to the future.** A common theme in much of the recent academic literature on environmental policy and improvement is that collaborative efforts and creating partnerships will be increasingly important to supplementing regulatory approaches to environmental improvement. Many corporate environmental leaders believe that society is just beginning to scratch the surface of partnership opportunities – partnerships between companies, between companies and NGOs, between companies and government, and between government and NGOs.

5. **Look for horses riding in the direction you want to go.** Change is difficult. Lasting behavior and culture change requires powerful and sustained motivators to counteract the forces of inertia and the costs of change. The State will be well served to leverage trends and third party actions that are fostering the desired behaviors and outcomes needed to reach the Beyond Waste Vision. Trends such as increasing community interest in local environmental quality and expanding information access and analysis over the internet are altering the social license to operate. The State can support these trends by expanding efforts to share environmental information with the public. Other trends, such as the explosive growth in lean manufacturing implementation and advances in environmentally friendly technologies, are altering the economic license to operate. The State can seek to remove regulatory obstacles to these trends, and to support or supplement the trends with information, partnerships, and resources.

6. **Bold change requires bold commitment and culture change.** Achieving a vision as bold as the Beyond Waste Vision will require significant commitment, investment, and culture change. These bold changes will not happen overnight; rather, they will occur incrementally as described in principle 3. Ecology and the broader government of the

[82] These observations are drawn from literature on change management, as well as discussions with business leaders about their experiences in transforming large organizations to advanced manufacturing paradigms. Also see Peter Senge. 1990. *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday.

State of Washington must develop commitment, invest resources, and work to change organizational cultures that have often focused on regulation and enforcement rather than integrated strategies for achieving a desired vision or outcome. In fact, the inability of governments to transform their organizational culture consistently has been identified as a primary barrier to innovative and collaborative approaches to environmental improvement. Requiring bold change from economic actor sectors also will prove difficult if government behaviors and performance outcomes are lagging behind. Government commitment, investment, and culture change does not need to be a prerequisite for starting toward the vision, but it needs to be an integral part of the State's strategy to achieve the Beyond Waste Vision.

These principles form the backbone of the Action Plans presented in Beyond Waste Consultant Team Issue Papers 3-5. The Action Plans represent robust starting points for the State to begin working toward the Beyond Waste Vision in Washington State. However, the framework for thinking about the Washington waste system that is presented in this paper provides Ecology with the means to identify initiatives and design action plans to implement them at any time along the path to Beyond Waste.

Appendix A

HAZARDOUS WASTE PROJECTION METHODOLOGY

OVERVIEW

The Waste Quantity Forecasting Tool was designed to project Washington State's recurrent hazardous waste generation. The methodology used in defining recurrent waste is consistent with the Department of Ecology's methods. To develop a waste quantity forecast for each two-digit SIC industry code, Ross & Associates combined historical estimates of Gross State Product (GSP), historical and projected Washington State employment data, and reported recurrent waste to derive a waste generation factor for the 2000 baseline year. This factor was then used to project future waste generation based on industry GSP estimates.

FORECASTING TOOL METHODOLOGY

The Waste Quantity Forecasting Tool bases calculations on the following methodology.

FOR YEARS 1989 THROUGH 2000

- Historical data sources were used to calculate annual worker productivity, defined as output divided by employment. Real Chained Gross State Product (GSP) is the indicator for output, while Sector Employment is the indicator for workers.
    - Washington State GSP data are available from the United States Bureau of Economic Analysis--http://www.bea.doc.gov/bea/regional/gsp/
    - Sector Employment is available from the Washington State Employment Security Department—www.wa.gov/esd/lmea/download/download.htm
- Waste Quantity[83] is then divided by output to estimate tons generated per dollar of output, creating an Industry Waste Factor. This calculation was done only for 2000, the baseline year used for this analysis.[84]

FOR YEARS 2001 THROUGH 2010

- An ordinary least squares (OLS) regression analysis conducted on the actual 1989 through 2000 data projects annual worker productivity for each year 2001 through 2010.
- Output is derived by multiplying projected annual worker productivity by Sector Employment projections prepared by the Washington State Office of Financial Management's Forecasting Division (http://www.ofm.wa.gov/demographics.htm).
- Waste Quantity is the product of projected output and the 2000 Industry Waste Factor.

[83] Figures for Waste Quantity are derived from a manipulation (querying and summing) of an Ecology HWIMsy dataset. HWIMsy is the Ecology's hazardous waste data system.

[84] Note that Ecology's dangerous waste reporting in 2000 used the North American Industry Classification System (NAICS), while the Washington State Office of Financial Management (OFM) and Unites States Bureau of Economic Analysis (BEA) have retained use of the Standard Industrial Classification (SIC) system. As a result, to utilize BEA and OFM data, Ross & Associates needed to translate NAICS-based generation data to an SIC format. This translation required Ross & Associates to cross-walk each NAIC code to a two-digit SIC code to query the dangerous waste dataset correctly. Also note that, in certain instances, official "cross-walks" prepared by the United States Census Bureau map certain individual NAICS codes to more than one two-digit SIC code. To avoid double counting generation totals, Ross & Associates needed to select the individual two-digit SIC code that would best represent the NAICS code. .

FORECASTING TOOL PROCESS

Ross & Associates obtained U.S. national worker productivity data from BEA sources. Washington State data were analyzed for unlikely trends or anomalies and then compared to U.S. data. Anomalies were investigated by contacting the BEA for further clarification of GSP data. The information in this section is based upon the BEA's response to our questions except where noted.

This review dictated the following adjustments to derived data:

SIC 24 (Lumber and Wood Products) Regulations limiting the supply of harvestable timber have driven Washington worker productivity down over the last ten years, according to a Washington State Employment Security Department report. This decrease in productivity created an unlikely trend in GSP/Employment using the Forecast Tool methodology. Productivity is projected to fall at a slower pace as supply has stabilized. To correct for this anomaly, the United States worker productivity trend for the Lumber and Wood Products sector from 1989 through 2000 was used to project Washington State worker productivity for 2001 through 2010.

SIC 27 (Printing and Publishing) An unidentified factor is pushing worker productivity down. This decline could be the result of a switch to part-time employees or the industry leaving the state, creating an unlikely worker productivity trend. Productivity is projected to decline at a slower pace than reflected by the Forecast Tool methodology. To address this anomaly, the United States worker productivity trend for the Printing and Publishing sector from 1989 through 2000 was used to project Washington State worker productivity for 2001 through 2010.

SIC 28 (Chemicals and Allied Products) Between 1999 and 2000, biotechnology companies in Washington State made large, lump sum, one-time, and stock option payments. These payments substantially inflated state GSP for those years. To account for this imbalance, 1999 and 2000 GSP are imputed based on worker productivity projections from 1989 through 1998 and actual employment for 1999 and 2000.

SIC 38 (Instruments and Related Products) Real price declines drove Washington GSP down swiftly between 1990 and 2000, creating an unlikely worker productivity trend. Future productivity is projected to decline at a slower pace than would have been derived from using the data. As a result, the United States worker productivity trend for the Instruments and Related Products sector from 1989 through 2000 was used to project Washington State worker productivity for 2001 through 2010.

DEFINITIONS

Gross State Product (GSP): The value-added production of goods and services within the state. "Value-added" is defined as the final sales in a given sector less the value of intermediate goods and services purchased to facilitate production. In general, this metric can be measured as the sum total of payments to the factors of production, namely labor and capital. GSP is broken down into compensation of employees, indirect business tax and non-tax liability, and property type income.[85]

Sector Employment: The total number of individual people working within a sector, with no adjustment made for full-time equivalents. For 1989 through 2000 actual data as reported by

[85] Data source: United States Bureau of Economic Analysis

Washington State employment data systems was used. 2001 through 2010 data is taken from OFM projections.

ECOLOGY HWIMSY DATASET

Ross & Associates requested that Ecology query the HWIMsy database for the following data elements to be used in the waste forecast projections:

- EPA ID
- Company name and address
- North American Industrial Code Standard (NAICS) code
- Origin code
- Form code
- Source code
- Treatment by generator (TBG) indicator
- Permit by rules (PBR) indicator
- Mixed radioactive indicator
- Management System Type (MST) – on- and off-site
- Total hazardous waste generation for MST – on- and off-site
- Total hazardous waste for total generation[86]
- EPA destination ID
- Destination
- Year

DATA PREPARATION PROCESS

To be consistent with previous Ecology Dangerous Waste data analysis efforts including the *Reducing Toxics in Washington 1999 Annual Progress Report*, Ross & Associates focused on preparing the dataset to produce an annual generation total for primary, recurrent, non-wastewater, and non-mixed radioactive waste. To produce this dataset, the following steps were taken:

- Ross & Associates asked Ecology to remove commercial Treatment, Storage, Disposal, and Recycling (TSDR) facility generators from the dataset. TSDR facilities are "secondary" generators of dangerous waste, as they receive previously

[86] The reporting logic used by the Ecology Generation and Management Form asks generators to provide dangerous waste total volumes managed during the reporting year. As a result, annual totals are not, technically, annual generation, but rather the total waste managed during the year. This total can include some waste generated in the previous reporting year but managed in the current year and exclude some waste generated but not managed in the current year.

generated waste from off-site and then generate "new" waste during the course of treatment, and, in effect, create a double count of generation in the dataset.[87]

- Ross & Associates asked Ecology to remove generation totals associated with waste "managed" through storage/transfer (MST141/142);
- Ross & Associates removed the high volume, low concentration wastewater wastes flagged in the dataset as Treatment-by-Generator (TBG) and Permit-by-Rules (PBR). Ecology typically has removed these wastes from generation totals because their very large relative volume distorts generation totals;
- Ross & Associates removed mixed radio-active wastes;
- Ross & Associates removed waste flagged in the dataset as origin code 4 because that code indicates a storage/transfer waste stream.

QUERYING THE DATASET AND POPULATING THE WASTE QUANTITY FORECASTING SPREADSHEETS

Ecology requested that Ross & Associates produce two products from 2000 Dangerous Waste data:

- Current and projected recurrent waste generation by industrial sector; and
- Current and projected demand for commercial dangerous waste management capacity by MST.

To produce current and projected generation by industry sector, Ross & Associates performed the following steps:

- Queried the dataset using the following data elements:
  - NAICS code (which NAICS depended on which two-digit SIC level);
  - Origin Code (only origin code 1, 3, and 5, which represent recurrent waste);
  - Year (only 2000); and
  - Total generation of hazardous waste.
- Exported query data into the master waste forecast projections Excel spreadsheet. These data were incorporated under the appropriate industry sector.
- Summed the data by total generation of hazardous waste.
- Linked this summation to the appropriate industry sector spreadsheet, specifically Waste Quantity column for year 2000.

To produce current and projected generation by MST for off-site capacity demand, Ross & Associates performed the following steps:

- Queried the dataset using the following data elements—
  - NAICS code (which NAICS depended on which two-digit SIC level)
  - Origin Code (only origin code 1, 3, and 5, which represent recurrent waste)
  - Year (only 2000)
  - MST off-site
  - Total hazardous waste for off-site MST

[87] See Table A-1 for the list of TSDR facilities Ecology did not include in the dataset.

- Exported query data into the master waste forecast projections Excel spreadsheet. These data were incorporated under the appropriate industry sector.
- Sorted the data by off-site MST in ascending order.
- Subtotaled, using the sum function, total hazardous waste by MST.
- Linked the MST subtotals to the appropriate industry sector spreadsheet, specifically the particular MST. For instance, industry sector food and kindred products contains MST 23, 29, 43, 51, 61, and 135,[88] so only columns that represented these MST were linked to the subtotals of hazardous waste by MST for year 2000.

Please note that because the SIC summary worksheets were pre-calculated, once MST subtotals and NAIC totals were linked the summary worksheet calculations automatically populated the appropriate cells and columns.

Waste generation activity on volumes contained in the dataset were associated with the following industry sectors (categories):

- Food and kindred products (SIC 20)
- Apparel and other textile products (SIC 23)
- Lumber and wood products (SIC 24)
- Furniture and fixtures (SIC 25)
- Paper and allied products (SIC 26)
- Printing and publishing (SIC 27)
- Chemicals and allied products (SIC 28)
- Stone, clay, glass, and concrete products (SIC 32)
- Primary metal industries (SIC 33)
- Fabricated metal products (SIC 34)
- Industrial machinery and equipment (SIC 35)
- Electrical and electronic equipment (SIC 36)
- Other Transportation (370)
- Aerospace (373)
- Instruments and related products (SIC 38)
- Miscellaneous manufacturing industries (SIC 39)
- Construction (SIC 15-17)
- Government (SIC 91-97)
- Mining (SIC 10-14)
- Retail (SIC 52-59)
- Services (SIC 70-89)
- Transportation, Communication, & Utilities (SIC 41-49)

[88] MST 135 and 136 were not used within the waste forecast projection worksheets because these types of management are associated with the management of wastewaters, which have been deliberately excluded from the analysis. MST 135 and 136 represent discharge to sewer/POTW and to surface water under NPDES.

- Whole (SIC 50, 51)
- EMNO-Textiles, Petroleum, Rubber, & Leather (SIC 22, 29, 30, 31)

Table A-1: Removed Transfer/Storage/Disposal/Recycle Facilities

Ecology provided this list to Ross & Associates on June 28, 2002. This is a list of all the known Transfer/Storage/Disposal/Recycle facilities from 1995 to 2000 for Washington. These TSDR facilities were removed from Ecology's Dangerous Waste dataset.

Washington TSDR Facilities 1995-2000						
FS_ID	FEDERAL_PROGRAM_ID	COMMON_NM	Commercial	Hanford	Immediate Recycler	Used Oil
8392414	WAD000712059	Safety Kleen Systems Inc Auburn	Y	N	N	N
17964725	WAD027530526	Bay Zinc Co Inc	Y	N	N	N
85799162	WAD980976906	Hallmark Refining Corp	Y	N	Y	N
7487639	WAH000003111	McClary Columbia	Y	N	Y	N
82621489	WAD981769110	Emerald Petroleum Services Inc	Y	N	N	N
13862483	WAD067548966	Vopak	Y	N	N	N
3476167	WAR000010355	ATG Richalnd	Y	Y	N	N
53734972	WAD000712042	Safety Kleen Systems Inc Lynnwood	Y	N	N	N
1018	WAD092300250	Burlington Environmental Inc Washougal	Y	N	N	N
37982391	WAD980738512	CleanCare Corp	Y	N	N	N
458	WAD009477175	Cameron Yakima Inc	Y	N	N	N
1233	WAD020257945	Burlington Environme	Y	N	N	N

Washington TSDR Facilities 1995-2000						
FS_ID	FEDERAL_PROGRAM_ID	COMMON_NM	Commercial	Hanford	Immediate Recycler	Used Oil
		ntal Inc Tacoma				
22218195	WAD000812917	Burlington Environmental Inc Pier 91	Y	N	N	N
70726415	WAD991281767	Burlington Environmental Inc Kent	Y	N	N	N
47779679	WAD000812909	Burlington Environmental Inc Georgetown	Y	N	N	N
63858257	WAD000712034	Safety Kleen Systems Inc Spokane	Y	N	N	N
56951146	WAD988499349	Total Reclaim	Y	N	Y	N
5167594	WAH000005025	ECCO Inc	Y	N	Y	N
41998995	WAH000007013	SQG Specialists	Y	N	Y	N
87313749	WAD980978746	Safety Kleen Systems Inc Pasco	Y	N	N	N
44846863	WAD037991528	Washington Chemical	Y	N	N	N
47473155	WA7890008967	US DOE Hanford Facility	N	Y	N	N
810	WAD087462503	Fuel Processors	Y	N	N	Y
2216	WAD980974521	Marine Vacuum Service	Y	N	N	Y
1317	WAD988475323	Spenser Environme	Y	N	N	Y

Washington TSDR Facilities 1995-2000						
FS_ID	**FEDERAL_PROGRAM_ID**	**COMMON_NM**	**Commercial**	**Hanford**	**Immediate Recycler**	**Used Oil**
		ntal				
62823862	WAR000010785	Phoenix Environmental	Y	N	N	Y
1245	WAD980511729	Petroleum Reclaim Service	Y	N	N	Y
41264211	WAD988512026	Northwest Recycling	Y	N	N	Y
47231541	WAD068794387	Emerald Petroleum Services Inc	Y	N	N	Y
32674489	WAD980987622	First Recovery	Y	N	N	Y
83476734	WAD988477501	Basin Oil	Y	N	N	Y
20647549	WAD980978142	Reflex Recycling	Y	N	N	Y
88713199	WAH000003582	Ecolights (Total Reclaim)	Y	N	N	Y
2155	WAD058367152	Emerald Petroleum Services Inc	Y	N	N	Y

Appendix B

TOOLS MATRIX

Appendix C

ADDITIONAL DETAIL ON INITIATIVES

1. ENCOURAGE A GREEN BUILT ENVIRONMENT

Description: The construction sector generates nearly one-quarter of all solid waste in the state. The goal of this initiative is to reduce construction waste, employ substitutes for hazardous materials, and use wastes as raw materials in new building products; and increase the use of sustainably produced building materials, as well as to decrease use of virgin resources, such as wood.

Leverage Points: Product design; choice of raw materials; disposal or treatment of waste materials, byproducts, and releases

Baseline: Approximately 1.7 million tons of C&D disposed, and 1.2 million tons recycled/down-cycled (mostly concrete); minimal but growing use of sustainably produced building materials.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
Construction	C&D Waste	▪ Increase cost of virgin materials ▪ Certification (such as LEED). ▪ Tip fee incentives ▪ Disposal bans ▪ Mandatory source-separation ▪ Education and promotion	1.0 million tons re-used or collected for recycling
Industrial & Manufacturing	Products	▪ Product Stewardship/Product Design initiative to use recycled C&D materials, and design for recyclability	Producers design for recyclability and incorporate recycled feedstocks into products. New construction materials are safe, and arsenic-treated wood and other existing hazardous substances are managed with vigilance.
Government	Building materials CO_2 emissions	▪ Increase government green building initiatives, mandates, use of LEED certification	Helps create markets for green building materials and services

2. ELIMINATE WASTES AND HAZARDOUS/TOXIC SUBSTANCES FROM INDUSTRY

Description: The industrial sector generates about 16% of the solid waste disposed in Washington, and much of it goes to limited-purpose landfills. The goal of this initiative is to eliminate solid and hazardous wastes, as well as toxic releases, from industrial sources, and to reduce the use of virgin materials.[89]

Leverage Points: Choice of raw materials; product design; management of waste materials, byproducts and releases; packaging choices

Baseline: 1.1 million tons of solid waste disposed, 0.2 million tons of hazardous waste generated, and almost 16,000 tons of toxics released by industry.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
Industrial	All	• Use pricing and fee strategies to discourage use of toxic materials • Create incentives for reuse and recycling • Product Stewardship/Product design initiative to cycle technical materials and design for take-back and recyclability • Technical assistance	▪ 1.1 million tons of solid waste diverted ▪ 0.2 million tons of hazardous waste eliminated ▪ 16,000 tons of toxics dramatically reduced

[89] For more detail on industrial generators in Washington State, please see Table A-2.

3. REDUCE MATERIAL CONSUMPTION AND TOXICITY IN WHOLESALE/RETAIL TRADE

Description: The goal of this initiative is to improve packaging effectiveness and efficiency, reduce the use and handling of potentially toxic or hazardous materials, and minimize waste associated with convenience products. In addition, this initiative would seek to use the power of the wholesale & retail trades to influence the behavior of its critical customers, namely the manufacturing/industrial and residential sectors.

Leverage Points: The purchase of consumer goods; packaging choices

Baseline: 700,000 tons of waste disposed, wholesale/retail trades have a vast distribution network to supply residential and commercial sectors with their products, including many disposable products and large quantities of packaging. This distribution network is, as of 2001, almost exclusively one-way, and is not utilized for product or material collection.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
Wholesale/Retail	▪ Packaging ▪ Toxics/ Hazardous wastes ▪ Disposable products	▪ Packaging-related fees and incentives ▪ Toxics and hazardous-materials related fees and incentives ▪ Incentives for wholesale/retail trade to partner with manufacturers in Product Stewardship initiatives ▪ Increased product labeling to increase production and content transparency	▪ 0.4 million tons of packaging waste eliminated ▪ Retailers and wholesalers pressure manufacturers to reduce toxics/hazards ▪ Retailers and wholesalers participate in Product Stewardship

4. REDUCE MATERIAL CONSUMPTION AND TOXICITY IN THE RESIDENTIAL SECTOR

Description: The residential sector generates about a third of the solid waste disposed in Washington. The goal of this initiative is to change consumer purchasing behavior and disposal practices, with particular focus on packaging, waste associated with convenience or disposable products, and products containing hazardous constituents.

Leverage Points: Purchase of consumer goods; disposal of consumer goods

Baseline: About 2.4 million tons of waste disposed in 2000. About 1% is hazardous, but this doesn't include toxic components incorporated into products.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
Residential	▪ Packaging ▪ Disposable & convenience products ▪ Toxics/hazards	▪ Packaging-related fees and incentives to influence consumer choice ▪ Increased product labeling to inform consumers about toxics/hazards content and production practices ▪ Education and Promotion	▪ Hundreds of thousands of tons of packaging waste source-reduced or recycled ▪ Increasing consumer action informed by labeling and education

5. ESTABLISH A VIABLE ORGANICS CYCLE

Description: Organics is over one-quarter of all solid waste. Composted organics can be used instead of chemical fertilizers and help reduce need for pesticides in agricultural and landscaping applications used by many economic actor sectors. The goal of this initiative is to recover organic matter as an input to agricultural, commercial, or home gardening activities. Improve overall soil quality through the introduction of organic material, and inherent nutrients, thereby reducing use of synthetic fertilizers and runoff.

Leverage Points: Purchase and disposal of consumer goods; product design; choice of raw materials by the manufacturing and construction sectors.

Baseline: Over 2.2 million tons disposed, over 0.7 million tons composted.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
Residential	Food, Yard Waste, Compostable Paper, Wood Waste, Textiles	▪ Pay-As-You-Throw rate structures ▪ Disposal bans ▪ Voluntary source-separation with price incentives ▪ Mandatory source-separation ▪ Education and promotion	1.0 million tons composted
Restaurants, Grocers, and Institutions	Food Waste	▪ Mandated source-separation (or on-site composting) ▪ Education and promotion	0.3 million tons composted
Other Commercial	Food, Yard Waste, Compostable Paper, Wood Waste, Textiles	▪ Pay-As-You-Throw rate structures ▪ Disposal bans ▪ Mandatory source-separation ▪ Education and promotion	0.9 million tons composted
Industry	Paper, Wood, etc.	▪ Product design initiative/product stewardship to encourage design for compostability	Increase compostability of wood, paper, and other products by removing potential contaminants
Agriculture	Crop Residues Pre-consumer losses	▪ Mandate orchard waste cleanup ▪ Introduce incentives for farms to use organic material instead of synthetic fertilizers	Fewer burns, agriculture becomes destination for compost and reduces chemical use
Government	Product inputs	▪ Institute aggressive use of organics in place of chemicals on publicly-managed lands	Helps create markets for composted materials
Local governments and waste haulers	Food, Yard Waste, Compostable Paper, Wood Waste, Textiles	▪ Create infrastructure for organics collection.	Infrastructure created, in conjunction with technical nutrient infrastructure

6. CREATE A TECHNICAL NUTRIENT CYCLE

Description: Technical nutrients represent over a quarter of the waste stream, and collection systems for most of them are already in place in the form of recycling programs. This initiative would return technical materials (i.e. plastics, glass, metal, etc.) to the economy for use at the same or higher value. It would develop infrastructure and policies to keep these materials continuously cycling in the economy while minimizing down-cycling into lower-value products, and address associated hazardous or toxic substances, such as heavy metals in electronics or even antimony in PET plastic, that can contaminate technical nutrients.

Leverage Points: Purchase of consumer goods; disposal of consumer goods; product design; choice of raw materials.

Baseline: Over 1.5 million tons collected for recycling/down-cycling, 1.7 million tons disposed

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Target Outcome
All	▪ Plastics ▪ Metals ▪ Glass ▪ Paper/Fiber ▪ Wood ▪ Electronics	▪ Increase disposal fees/taxes (including PAYT) ▪ Disposal bans ▪ Mandatory source-separation ▪ Education and promotion	All technical materials collected for re-use or re-manufacture
Industrial & Manufacturing	Products	▪ Product stewardship/product design initiative to cycle technical materials and design for take-back and recyclability ▪ Backhaul subsidies ▪ Local use subsidies ▪ Increase disposal fees/taxes ▪ Technical assistance	1.7 million tons of material entered into closed-loop technical cycles
Government	Product inputs	▪ Increase green purchasing and procurement	Helps create markets for products made from continuously-cycling nutrients
Local governments and waste haulers	▪ Plastics ▪ Metals ▪ Glass ▪ Paper/Fiber ▪ Wood ▪ Electronics	▪ Create infrastructure for collection of technical nutrients.	Infrastructure created, in conjunction with organics/compostables collection infrastructure

7. ALIGN PRICE SIGNALS TO REDUCE WASTE AND ELIMINATE TOXICS

Description: The generation of many wastes and toxic substances may be influenced by setting appropriate fees and prices to encourage efficiency or use of alternate products. The goal of this building block is to use fee and pricing strategies to change purchasing behavior and disposal practices of all economic actor sectors, with particular focus on toxic materials and virgin resources (such as wood).

Leverage Points: Choice of raw materials, product design, the use of chemicals in agriculture and forestry (i.e., the process for growing and harvesting raw materials), and packaging choices.

Baseline: In 2001, the true environmental cost of most materials is not adequately reflected in their prices, either as raw materials or when incorporated in final products.

Elements:

Target Economic Actor Sector	Target Waste(s)	Possible Policies and Tools	Expected Results
All	▪ Toxics ▪ Hazardous chemicals ▪ Virgin materials	▪ Hazardous waste fees ▪ Taxes/fees on toxic constituents	Dramatic reduction in use, handling, sale, and consumer purchase of hazardous chemicals and toxic substances